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Teck American Incorporated
501 N Riverpoint Blvd., Suite 300
Spokane, WA 99202
PO Box 3087
Spokane, WA 99220-3087

+1 509 747-6111 Tel
+1 509 922-8767 Fax
www.teck.com

Teck

January 20, 2014

File No.: 01-773180-000

Dr. Laura C. Buelow
Project Manager, Hanford/INL Project Office
U.S. Environmental Protection Agency, Region 10
309 Bradley Boulevard, Suite 115
Richland, WA 99352

Subject: Upper Columbia River Remedial Investigation Feasibility Study (UCR RI/FS)
Draft Final Version *Assessment of Sediment Toxicity to White Sturgeon Data Summary Report* (January 2013)

Dear Dr. Buelow:

On behalf of Teck American Incorporated, I am pleased to submit for your review and approval the above-referenced data summary report. The enclosed report has been revised in response to comments received on June 14, 2013 from the U.S. Environmental Protection Agency (EPA). To facilitate your review, we have attached EPA's comments and our associated responses (including the edits made within the report as appropriate). We wish to confirm that, as with all technical deliverables, an electronic version of the enclosed report will be posted on the secure domain of the project website in the very near future.

We look forward to your comments in the near future and should you have any questions or require any additional information at this time, please do not hesitate to contact me directly at (509) 623-4501.

Sincerely,
Teck American Incorporated

Kris R. McCaig

Kris R. McCaig
Manager, Environment and Public Affairs

Enclosures – 1 hard copy (includes compact disc) *Draft Final Version Assessment of Sediment Toxicity to White Sturgeon Data Summary Report (January 2013)*
Attachment – 1 hard copy *TAI Response to June 2013 EPA Comments on the Draft Version Assessment of Sediment Toxicity to White Sturgeon Data Summary Report (December 2012)*

cc: Matt Wilkening U.S. Environmental Protection Agency, Boise, ID, Enclosure (1) Attachment (1)
Monica Tonal, U.S. Environmental Protection Agency, Seattle, WA, Enclosure (1)
John Roland, Department of Ecology, Spokane, WA, Enclosure (1)
Patti Bailey, Colville Confederated Tribes, Nespelem, WA, Enclosure (1)
Randy Connolly, Spokane Tribe of Indians, Wellpinit, WA, Enclosure (1)
Dan Audet, National Park Service, Spokane, WA, Enclosure (1)
Dr. Anne Fairbrother – Exponent, Inc., Bellevue, WA, Enclosure (1)
Dr. Mark Velleux – HDR, Mahwah, NJ, Enclosure (1)

EPA Comments on the UCR Draft Assessment of Sediment Toxicity to White Sturgeon Data Summary Report (December 2012)

General Comments (GCs)

GC-1 EPA has concluded there are three overarching study performance concerns with the white sturgeon (WS) sediment-toxicity data that demonstrate data obtained in several components of the study are not of sufficient quality or completeness to be used as a principal line of evidence in Remedial Investigations (RI) at the Upper Columbia River (UCR) site.

- The following factors during the sediment toxicity tests made it extremely difficult to identify an exposure concentration (e.g., a mean or other central tendency concentration to which sturgeon were exposed): 1) Differences in individual metal concentrations in the overlying water (OW), sediment-water interface water (SWIW), and sediment pore water (PW), 2) High variability in metal concentrations within each water fraction of individual exposure chambers during the course of the toxicity tests (up to and exceeding an order of magnitude). Although steady state conditions are not necessary to elicit toxicity, steady state conditions (or at least constant exposure concentrations) are required to calculate statistically reduced descriptors of toxic effects (e.g. EC_{20} concentrations for reduction in growth) with acceptably narrow confidence intervals. Several potential sources of the within replicate variation in exposure concentrations over time, particularly in porewater and sediment-water interface water, can be postulated. Regardless of the cause(s) of the observed within replicate exposure concentration variation, the end result is a series of sediment exposures too variable to permit accurate quantification of either contaminant concentrations to which sturgeon were exposed. Similarly, it was not possible to discern the magnitude of adverse effects on sturgeon at different exposure concentrations, or to identify the relative importance of different contaminant exposure routes to contaminant toxicity. Uncertainties regarding sediment contaminant bioavailability of UCR sediments led to a recommendation that the bioavailability of sediment-associated contaminants be better defined before any additional sediment toxicity tests with demersal fish species are considered at the UCR site (also see GC-8).

Comment Response. TAI would like to remind the U.S. Environmental Protection Agency (EPA) and its project partners of the primary purpose of this Study. As noted within Section A7.2 "Step 2 – Identify the Goal of the Study" of the EPA-approved Quality Assurance Project Plan (QAPP), the goal of the Study was "*to evaluate if COPCs associated with granulated slag in sediments in the UCR Site present an unacceptable risk to the survival and growth of white sturgeon during the first 2 months of life.*" Specific risk-related questions to be addressed during the study were: "*Are there significant differences in acute and/or subchronic effects on survival, growth, and biomass on white sturgeon ELS raised on Site and reference sediments?*" It is important to note that the primary study question can wholly be answered with the biological data (i.e., number of survivors, length, and mass). The collection and analyses of analytical data (e.g., water and sediment chemistry) is only needed to help interpret results if significant differences occur. As outlined within the EPA-approved QAPP, if significant differences were recorded subsequent Study questions to be addressed were: "*What is the magnitude of these effects?*" and "*Are these effects due to slag-associated COPCs as measured in sediments, porewater, and overlying water?*" As outlined within the data summary report, data collected throughout the Study were of sufficient quality to address Study questions. With respect to results of this study being used as principle line of evidence within the remedial investigation, TAI would like to remind EPA and its project partners of the principle lines of evidence (LOE) outlined within the EPA-approved Baseline Ecological Risk Assessment (BERA) work plan for bottom-dwelling (demersal) fish species such as white sturgeon. These include surface water data

(completed), sediment and associated porewater data[1], and fish tissue (completed). As noted within Section 6.6.2 of the BERA work plan, given the demersal nature of white sturgeon, there was uncertainty if COPCs associated with granulated slag were chemically toxic to early-life stages of white sturgeon. Therefore, to address this data gap, subchronic (i.e., 40+-day) toxicity tests of sturgeon fry to sediment containing granulated slag were conducted. Results of the present Study have fulfilled and addressed the aforementioned data gap. Therefore, we respectfully disagree with EPA's assertion and dismissal of the data and believe that it can and should be used to help inform the Remedial Investigation/Feasibility Study. The purpose of this work was never intended to develop effective concentrations for a non-standard test species.

- There was a failure to obtain and test sediments encompassing the complete range of contaminant concentrations known to exist within the UCR. This failure precluded the study from meeting one of its primary objectives, which was to evaluate the following null hypothesis as stated in the study QAPP: *"There are no dose-dependent differences in survival, and growth of white sturgeon ELS as a function of COPC concentrations in sediments from the Site and at the point of exposure."*

Comment Response. TAI wholly disagrees with the mischaracterization of sampling efforts and sediment contaminant concentrations evaluated for this Study. Firstly and as clearly stated within the EPA-approved QAPP, the primary goal of the study was to determine if COPCs associated with granulated slag in UCR sediments were chronically toxic to white sturgeon ELS (including the hiding stage). As outlined within the aforementioned QAPP, COPCs associated with granular slag include cadmium, copper, lead, and zinc. Secondly, sediment concentrations collected and evaluated for the aforementioned COPCs are wholly within the targeted ranges illustrated within Maps A-2 and A-3 of the EPA-approved QAPP. Thirdly, and as expressed by calculating mean Probable Effects Concentration Quotient (mPECQ) site sediments had mPCEQs greater than the 95th percentile; while reference sediments were in the $\leq 3^{rd}$ percentile. Therefore, TAI believes that the study met its primary objectives as described in the QAPP.

- Variation in the number of organisms exposed to contaminants in the different exposure chambers introduced an unacceptable level of uncertainty in the effects determinations reported in the study. A fundamental experimental design requirement of most types of toxicity tests, including the sturgeon sediment toxicity tests, is that all exposure chambers, including all replicate chambers within each exposure concentration, contain identical numbers of test organisms at test initiation. The sturgeon sediment toxicity tests failed to meet this requirement resulting in an inability to describe the results of the toxicity tests. Counts of organisms in individual exposure chambers can be adjusted downward to account for the occasional loss of organisms at or near test initiation. But the number of organisms lost in some exposure chambers exceeded 20% of organisms, which may compromise interpretation of results. These losses, coupled with the addition of varying numbers of fish to chambers which lost fish, resulted in a wide range of fish in individual exposure chambers after the first two days of exposure to sediment (ranging from 61 to 170 fish/chamber; Table 2-4). The targeted number of fish per chamber was 100. This variation and uncertainty in the number of fish exposed to the various sediments means that the proportion of fish whose survival, growth and/or behavior was adversely affected in each chamber is not known with certainty and a primary DQO and risk question of the study *(Is the survival and growth of white sturgeon adversely affected when exposed to site sediments in comparison to reference sediments?)* cannot be answered with confidence.

[1] At the time of writing, data validation associated with recently collected sediment and porewater samples is ongoing and will be available in the near future.

Comment Response. Within the first 24-48 hours of exposure, sturgeon fry were observed escaping through gaps in seals located near the outflow of exposure chambers. Gaps in chamber screens were sealed and additional sturgeon fry were added to the chambers to restore target fish seeding densities to the extent practical (Deviation/Corrective Action (D/C) No. 8). This deviation was necessary to permit completion of the study and was not expected to adversely impact study results. There is a complete accounting of fish added to or removed from the chambers from the reseeding until study termination as presented in Table 5-4 of the revised report. Numbers of fish surviving through the end of the study were also recorded. This permits the initial number of sturgeon in each chamber to be calculated. To account for differences in the number of organisms over time, Kaplan-Meier survival analysis was performed. Survival analysis accounts for all individuals "at risk" (i.e., exposed) at each stage in the study and accounts for censoring caused by mortalities (or loss of fish) over time. Use of the Kaplan Meier survival analysis approach is consistent with EPA Office of Research and Development (ORD) peer review recommendations, which are presented in Appendix E (formerly Appendix D) of the revised draft data summary report. Additionally, differences in seeding density were taken into account and removed as a confounding variable when conducting statistical comparisons among treatments. Therefore we believe that any potential uncertainty introduced due to variation in the number of organisms within exposure chambers has been accounted for using well accepted and robust statistical methods (i.e., Kaplan Meier survival analysis).

Revise the introductory paragraph as follows to clarify the utility of these data in the UCR RI:

"Data obtained during this work ~~will be used~~ were intended to supplement information in the baseline ecological risk assessment (BERA) and quantitatively assess the potential for UCR sediments to adversely affect early life stages on white sturgeon. However, the effects data and exposure chemistry data from the sediment toxicity tests are not sufficient quality for use in the BERA."

Comment Response. Some of the suggested language has been incorporated into the introductory paragraph of the revised data summary report which now reads as follows:

> *"Data generated in the sturgeon sediment toxicity study are intended to supplement information for the baseline ecological risk assessment (BERA). The use of these data in support of risk evaluations will be determined during the baseline ecological risk assessment process."*

EPA's suggested text is inappropriate for a data summary report.

GC-2 Data quality objectives and outcomes are not adequately described or presented. Include a description of each data quality objective (DQO) listed in the Quality Assurance Project Plan (QAPP) and discuss whether sufficient data were collected to meet each objective. For example, in addition to presenting acute toxicity data in Appendix B, the main text should identify the DQO for this study component (i.e., *"What is the relative sensitivity of white sturgeon ELS compared to rainbow trout as determined in acute toxicity tests with copper at 15 and 45 dph?"*). Note that DQOs also include developmental and behavioral observations (QAPP page A-9 and Table B-12) which are not currently discussed in the draft report. Data related to these DQOs, or the reason for excluding them, must be included in the report.

Comment Response. We respectfully disagree. Section 1.1 of the draft data summary report titled "Purpose and Data Quality Objectives" clearly lists Study objectives; Section 4 provides details associated with data validation, Section 5 presents and discusses Study results used in addressing data quality objectives; while Section 6 confirms that data quality objectives were met and that no significant data gaps were identified that would require additional data collection at this time. We appreciate EPA's suggestion for inclusion of study data quality objectives associated with the limited number of acute water exposure tests; however and as outlined within the data summary report, consistent with the format of the

EPA-approved QAPP data quality objectives results and discussions associated with the limited number of acute water exposure toxicity tests are independently presented within an Appendix B to the report. Therefore no edits in format are required. Furthermore, we would like to clarify that behavioral and developmental observations were not study objectives. Please note the QAPP citation in GC-2 above "(QAPP page A-9…)" refers to Section A7.3 Step 3 – Identify Information Inputs which does not present study objectives; study objectives are stated in Section A7.2 of the QAPP (see p. A-8) and do not include any developmental and behavioral endpoints. Therefore and consistent with the EPA-approved QAPP, developmental and behavioral observations were recorded during the study and have been added as Appendix I in the revised report.

GC-3 List all of the test acceptability criteria listed in the QAPP (Table B-9) and provide an assessment of how each criterion was met or not. For example, the draft report indicates that criteria were met for general water quality parameters (Section 5.2.1) and for overall control survival (Section 5.3.1) but there is insufficient information to determine if all other criteria were met (e.g., average hatching rate, survival to swim-up greater or equal to 80%). Data relevant to all test acceptability criteria (e.g., a table describing control survival from exposure day 0 to approximately day 20) must be added to the report and discussed.

Comment Response. There were seven (7) primary acceptance criteria and six (6) additional acceptance criteria for the study. These criteria and associated responses are summarized below:

Primary Acceptance Criteria

1. Freshly fertilized eggs from at least 2 to 4 different females and males are to be used (time between hatching and initiation of study must not exceed 24 hours).

   This is stated within Section 2.3 of the data summary report and as such, no further edits are needed.

2. Average hatching rate of eggs in the lab water controls should not be less than 60%, or within 90% confidence interval of that observed at the hatchery for the same fish.

   We wish to confirm the average hatching rate of eggs in laboratory control waters was 98.2% which is ≥60%; therefore meeting the above-listed acceptance criterion. We wish to confirm that despite wholly satisfying the above-mentioned criteria, information from the Hatchery have been requested but not yet been made available. We wish to confirm that as soon as the information is made available it will be provided for informational purposes. At this time however and in consideration of the fact that overall performance criteria outlined within the EPA-approved QAPP were met (see other responses), TAI did not wish to delay submittal of the draft final version of the data summary report.

3. Average survival of fry until swim-up in the lab water controls should be greater or equal to 80%, or within 90% confidence interval of that observed at the hatchery for the same fish.

   We wish to confirm and as noted within Section 5.3.1 of the data summary report average survival of fry until swim-up in laboratory control waters was ≥80% therefore meeting the above-listed acceptance criterion. We wish to confirm that despite wholly satisfying the above-mentioned criteria, information from the Hatchery have been requested but not yet been made available. We wish to confirm that as soon as the information is made available it will be provided for informational purposes. At this time however and in consideration of the fact that overall performance criteria outlined within the EPA-approved QAPP were met, TAI did not wish to delay submittal of the draft final version of the data summary report.

4. Average survival of fry from the start to finish of exposure in the lab water controls should be greater or equal to 64%.

   This is stated within Section 5.3.1 of the data summary report. In addition Table 5-4 has been added to the report that provides all the details associated with survival.

5. All water quality parameters with the exception of DO and temperature should not vary by more than 50% during the exposure.

   This is indicated within Table 5-2 of the data summary report and illustrated within Figures 5-8 through 5-16.

6. Dissolved oxygen should be maintained above 70% saturation.

   This is indicated within Table 5-2 of the data summary report and illustrated within Figures 5-8 through 5-16.

7. Average daily temperature should be maintained at 15 ± 1°C; the instantaneous temperature must always be within ± 3°C of 15°C.

   This is indicated within Table 5-2 of the data summary report and illustrated within Figures 5-8 through 5-16.

Additional Acceptance Criteria

1. All organisms must be from the same source.

   This is stated within Section 2.3 of the data summary report and as such, no further edits are needed.

2. Hatchability in the lab water controls should be comparable to those observed at the Kootenay Trout Hatchery for the fish from the same fertilization event.

   As outlined above, see response to Primary acceptance criteria for Item No. 2, we wish to confirm that despite wholly satisfying the aforementioned primary acceptance criteria, information from the Hatchery have been requested but not yet been made available. We wish to confirm that as soon as the information is made available it will be provided for informational purposes. At this time however and in consideration of the fact that overall performance criteria outlined within the EPA-approved QAPP were met (see other responses), TAI did not wish to delay submittal of the draft final version of the data summary report.

3. All test systems and chambers should be identical and should be run under the same recirculating conditions for each study, except if otherwise stated in the protocols.

   This is stated within Section 2.2 of the data summary report and as such, no further edits are needed.

4. Natural physicochemical conditions of the control lab water should be within the tolerance limit for white sturgeon early life-stages.

   This is indicated within Table 5-2 of the data summary report and illustrated within Figures 5-8 through 5-16.

5. Food should be obtained and tested for possible comparability with white sturgeon early life-stages prior to initiation of the studies.

   Commercially available fish foods used within this study were supplied by the San Francisco Bay Brand, Inc. A copy of the nutritional analysis of the bloodworms used in this Study as made available by the manufacture is listed below. In addition to the summary analysis, every package of frozen bloodworms is guaranteed to meet the following criteria: crude protein minimum @ 4 percent, crude fat minimum @ 0.4 percent, crude fiber maximum @ 0.7 percent, and maximum moisture @ 95 percent.

PET FOOD NUTRIENT ANALYSIS

Date Sampled	Received	Reported	Lab #
	07/05/12	07/09/12	9912813

Sample ID: FROZEN BLOODWORMS/88055/1712

ANALYSIS RESULTS

Component	As Sent	Dry Wt.
Moisture (%)	92.05	///////
Dry Matter (%)	7.95	///////
Crude Protein (%)	5.75	72.4
Acid Hydrolysis Fat (%)	0.93	11.7
Crude Fiber (%)	< 0.2	< 0.2
Ash (%)	0.81	10.2
Sulfur (%)	0.05	0.68
Phosphorus (%)	0.10	1.31
Potassium (%)	0.08	0.94
Magnesium (%)	0.014	0.181
Calcium (%)	0.02	0.19
Sodium (%)	0.13	1.61
Iron (ppm)	136	1714
Manganese (ppm)	2	30
Copper (ppm)	1	17
Zinc (ppm)	9	110

COMMENTS

1. Mineral analysis performed by ICAP using a wet digest procedure.
2. Analysis for:
(29557) SAN FRANCISCO BAY BRAND INC
Phone: (510) 792-7200

6. Reference toxicant (copper) will be tested in acute toxicity (96hr) water-only exposure, using a life stage previously tested at U of S and fish from the same batch of fish used in the sediment study.

   This is stated within Appendix B of the data summary report and as such, no further edits are needed.

GC-4 Data that should have been collected according to the QAPP are not presented in this draft report. The following data, or the reason for exclusion, must be included in the report:

a. Provide a summary table that includes WS length and weights at day 0 (QAPP Table B-10) – summary table and discuss any effects on endpoints.

Comment Response. The data requested in this comment are graphically presented in the report and electronically made available in the accompanying compact disc. Therefore the supposition that data were not presented is incorrect. Nevertheless in addition to the aforementioned data presentation and in response to this comment, a tabular summary of length and weight measurements near the start and end of the test has also been provided and is presented in Table 5-4.

b. Report the results of water-only reference toxicity testing (QAPP Table B-8).

Comment Response. Again the supposition that data are missing in this comment is false. Results of the water-only reference toxicity testing are already in Appendix B; and they are shown as the results of Treatment 0 and as such, no additional edits are required.

c. Behavioral observations must be discussed, described in a summary table, and documented in an appendix (QAPP page B-8 and Table B-12). Specifically, the QAPP requires detailed observation and reporting on searching, grazing, ingestion, hiding, schooling, swimming, lethargy, hyperactivity, loss of equilibrium, or lack of response behaviors.

Comment Response. Comment acknowledged. Behavioral observations were recorded in laboratory notebooks. This information is presented in Appendix I in the revised report.

> d. Developmental abnormalities must be discussed, described in a summary table, and detailed observation results documented in an appendix (QAPP; page B-8). Specifically, the QAPP requires that WS >50 days post-hatch be dissected and that morphological anomalies (e.g., tissue color, liver size, gut/stomach filling) recorded.

Comment Response. Development abnormalities were recorded in laboratory notebooks. This information is presented in Appendix I. Digital photographs of sturgeon were also taken and are presented in Appendix I. As indicated within Appendix I all fish were assessed for the external criteria listed, while a subset of fish were dissected and gut contents recorded. Due to the extremely small size of internal organs (e.g., liver) at this life-stage, accurate measurements can only be accomplished using a micro-balance and under conditions with absolutely no vibration or other disturbance. This in conjunction with the fact that over 3,000 fish had to be processed at study termination made such measurements simply not feasible.

> e. Section 2.6 should describe the sample storage location and availability of preserved fish (QAPP page B-6).

Comment Response. Fish were preserved in formalin at the completion of the study as described in the QAPP (Section B4.1). They are stored at the University of Saskatchewan.

> f. Photo documentation and measures of fish growth during the exposure must be discussed (QAPP page B-7). Details can be presented in an appendix.

Comment Response. See response to comment 4d above.

> g. Data and analyses were to be stratified by key life-stages (QAPP page A-13). *"Data will be aggregated for the entire exposure period of >60 days and also will be stratified by key life-stages, yolk sac larvae, transition to feeding, and juvenile. Thus, separate LC/ECx endpoints can be calculated for life-stage periods of interest such as 0 to 21 dph, 29 to 50 dph, and for the entire exposure period."* Expand upon the data analyses to stratify the survival, growth, and biomass endpoints and present these data in summary tables and figures.

Comment Response. Reviewers may have misunderstood the nature of experimental design for this study. Data can be stratified for the survival endpoint but cannot be stratified for growth (i.e., length or weight) endpoints. Biomass is not an appropriate endpoint for this study because non-mortality fish losses occurred.

The survival analysis documents survival for all treatments over the entire duration of the study. Survival data can be stratified into any period of interest because there was continuous record of fish mortalities for each exposure chamber over time. For example, during the initial part of the study from 1 to 14 dph, there was 100% survival in the Control (CTRL) treatment. During swim-up and transition to exogenous feeding, which occurred between 14 and 24 dph, there were 137 mortalities in the CTRL treatment and survival decreased to 71%. After transition to exogenous feeding and continuing until end of study, from 24 to 62 dph, there were an additional 8 mortalities in the CTRL treatment and survival decreased by an additional 2% to approximately 69%.

However, data for length and weight endpoints cannot be stratified. There were no sacrificial chambers to measure fish lengths and weights over time for any of the exposures (and none were specified in the QAPP). Lengths and weights were recorded at study start (3 dph) and study end (~60 dph). Although

lengths and weights were recorded for fish that died during the study, there were no measurements of surviving fish at intermediate times. The intermediate periods of time were intended to be specifically evaluated using data collecting from the parallel EPA-USGS study.

GC-5 Supporting data are missing or presented only in figures. These data must also be presented in tables. Add tables containing summary statistics (e.g., mean, max, min, standard deviation, and the number of samples) for the following:

> a. Present the length and weight of WS at the start of testing, length and weight of WS used in restocking after fish were lost/escaped, and length and weight of WS at times during the test when fish were removed from exposure chambers. Discuss any variability among the fish sizes and the potential influence of these starting sizes on the results.

Comment Response. Comment acknowledged. A summary of survival, mortalities, and losses along with starting and ending fish lengths and weights is presented in Table 5-4 of the revised report. As a consequence of organism losses due to gaps in screens, exposure chambers were re-seeded during the first 48 hours of the test. Starting weights and lengths were recorded after re-seeding occurred at an effective fish age of 3 dph (note that tests began at an effective age of 1 dph). Organism loss during toxicity tests is not unusual and was noted in ORD peer review comments. A potential impact of fish re-seeding is that a subset of organisms placed in exposure tanks at 3 dph would have been exposed for up to 48 hours fewer than organisms placed into chambers at 1 dph.

> b. Present WS survival, length, weight, and biomass. Survival data should be partitioned as described in General Comment 4g.

Comment Response. Survival, length, and weight were shown graphically for each treatment and/or tank. In addition to data already shown, tabular summaries of survival, length, and weight are now provided Table 5-4. Biomass values were not calculated because they would be biased as a consequence of non-mortality fish losses during the study. As an alternative, analysis of covariance (ANCOVA) was used to evaluate the effect of treatment (i.e., substrate) and other factors on fish growth while simultaneously accounting for fish density.

> c. Present metal concentrations, DOC and TOC, and sediment toxicity metrics (i.e., SEM-AVS and mPECQs in sediments at the beginning and end of the test.

Comment Response. We wish to confirm that the probability distributions for concentrations of primary analytes in bulk sediment as well as mPECQ and AVS-SEM metrics are presented in Figures 5-1 through 5-7 for both the beginning and end of the test. Distributions for additional analyses are presented in Appendix F (formerly Appendix E). Distributions for remaining analytes are presented in Figures 5-17 through 5-41. Where applicable, these distributions include measurements at the beginning and end of the test. Furthermore, the full and complete data set is in the project database (http://teck-ucr.exponent.com) and available for reviewers to query.

> d. Present metal concentrations in PW, SWIW, OW, in each treatment, and by each method (e.g., diffusive gradient thin-films [DGTs], peepers, and air stone methods were used to evaluate pore water) for each sampling period.

Comment Response. Table 5-3 in conjunction with Figures 5-17 through 5-37 clearly provides a summary of the above requested information. Furthermore, the full and complete data set is in the project database (http://teck-ucr.exponent.com) and available for reviewers to query.

GC-6 Respond to issues raised by the Office of Research and Development (ORD) peer review. While their review of the data was conducted after the experiment was completed and could not influence the methods, an accurate reflection of the test data is needed in response to the comments made by the ORD peer reviewers.

Comment Response. The EPA ORD Peer review was summarized in Section 3.3 of the Draft DSR with an overall summary of Peer Review panel findings on p. 3-6 as repeated here:

> "In short, peer reviewers confirmed that in consideration of change orders (Section 3.1) and deviation/corrective actions (Section 3.2), the method performance generally met DQOs and the overall Study goal; and recommended that for those age categories with high control mortalities, effect concentrations should be viewed as uncertain. Peer reviewers believe that toxicity testing of the organisms was undertaken before successful baseline culturing techniques were established for this species, especially during transition to exogenous feeding (page 7 of 9).' A copy of ORD's findings and recommendations is available within Appendix E (formerly Appendix D)."

a. Evaluate the biomass endpoint and present graphically as done for survival, length, and weight.

Comment Response. See response to Comment 4g and 5b. Biomass is not a valid calculation when non-mortality losses occur.

b. The peer reviewer's conclusion that WS were under-fed in this study should receive particular attention. Document the feeding regime and discuss the possible influence of underfeeding on toxicity endpoints.

Comment Response. The ORD Peer Review comment being referenced in this comment states *"However, based on the reviewers' understanding of the data in the tables provided, it appears as though the ending weights of control sturgeon in the long-term test conducted at the USGS lab were substantially larger than the ending control weights obtained in the long-term U of S test. These data suggest that either the U of S fish were underfed (compared with those in the USGS lab) or they were less able to convert food mass to tissue mass."* It is important to note that the ORD peer review comment does not conclude that fish in the assessment of sediment toxicity to white sturgeon (U of S Study) were underfed as suggested by EPA and its project partners. Rather the ORD peer review comment notes that ending weights between the two studies differed, and the reviewer postulated two (of many) potential sources for the difference. In the specific case of the U of S study, consistent with the EPA-approved QAPP sturgeon were fed *ad libitum*. Even when fed in this manner, differences between ending weights in the U of S and USGS studies could be attributable to factors other than food amount. For example, the source of sturgeon for the U of S and USGS studies differed; size differences could be attributable to differences between sources of eggs. More importantly, a major outcome of the U of S study is that sturgeon size was inversely related to the number of fish in each chamber. In contrast, the USGS study was designed to have fewer organisms in a chamber and to use a reduced number of fish per chamber as fish size increased during later parts of that study.

c. Discuss why the Lower Arrow Lake (LALL) reference sample data were within or outside of the expected results based on sediment metal concentrations and observed effects. This discussion should provide a rationale for accepting or rejecting the test data from this sample due to concerns that sediments were not completely homogenized.

Comment Response. As illustrated by Figures 5-1 through 5-5 sediment metal concentrations within Lower Arrow Lakes were consistently within the range of all reference sediments collected for this Study. Therefore the nature of the comment is unclear. Furthermore, it is important to note that as with all

reference samples the only expectation is that the selected reference area(s) satisfy desirable criteria for an aquatic reference area. These include (e.g., USEPA 1994): up-gradient in the same watershed as the study site, similar water depth and flow as the study site, similar sediment grain size distribution and sediment total organic carbon content as the study site, and relatively uncontaminated. Clearly reference samples collected for this work satisfied all of the above-listed criteria. Furthermore, there is no documentation of a deviation from the QAPP indicating that the LALL sample was not homogenized or was somehow unrepresentative. Therefore no edits are required the report.

> d. The ORD peer reviewers concluded *"... that results of tests conducted with animals in this life stage (pre- through post-transition to exogenous feeding] will provide a true measure of toxicity. In general, the reviewers believe that toxicity testing of the organisms was undertaken before successful baseline culturing techniques were established for this species, especially during transition to exogenous feeding."* The report also describes concerns with these data *"...lack of concordance between the analytical and biological data..."* Discuss how, despite the large amount of sturgeon toxicity testing work performed by both the University of Saskatchewan and the U.S. Geological Survey over the last several years, there remains poorly known facets of sturgeon early life stage life history that renders use of the species problematic in toxicity testing. Specifically, reasons for a high mortality of sturgeon fry of age 21-28 dph during the transition to exogenous feeding remain unknown. Nutritional and feeding rate requirements of sturgeon post-yolk sac resorption are also not fully known, and may be partially responsible for sturgeon growth in the University of Saskatchewan study being less than growth observed in the USGS studies. Light intensity and habitat structure within exposure chambers most supportive of sturgeon survival and growth are also not fully known. All of these unknowns add uncertainty to the utility of the toxicity test results (see also GC-9).

Comment Response. With the exception of work being performed in parallel by the U.S. Geological Survey for the Remedial Investigation/Feasibility Study and the "not to be cited" data presented within the EPA-approved QAPP, we are unaware of the above-mentioned large amount of work performed by the U.S. Geological Survey using white sturgeon[2]. Furthermore, we trust that during the development of the EPA-approved QAPP any knowledge from EPA and its project partners associated with the purported large amount of work would have been incorporated in the development of the QAPP. Regardless of the above-mentioned, it still remains a fact that white sturgeon are not a standard test species and as such and by default, is a less well characterized test organism than standard test species such as rainbow trout. It is not the purpose of a data summary report or the RI/FS to speculate on the "poorly known facets of sturgeon early life stage life history that renders use of the species problematic in toxicity testing." Furthermore, it is inappropriate for TAI to comment and/or compare results from a separate study which includes non-RI/FS data within the data summary report. Rather, the only purpose of the data summary report is to address and evaluate if study objectives as set-forth within the EPA-approved QAPP were satisfied. To the end and as detailed within the data summary report, the assessment of sediment toxicity to white sturgeon met study objectives by characterizing the response of ELS sturgeon reared in UCR site and reference sediments. Exposure regimes allowed comparison of survival and growth in fish reared in river sediments and reference sediments, and the occurrence and magnitude of adverse effects, if any. Use of ANCOVAs and Kaplan-Maier statistical techniques helped account for variability in responses. The purpose of this work is not to research the utility of white sturgeon as standard toxicity test organism, but rather fulfill study objectives.

GC-7 Dissolved organic carbon (DOC) concentrations were *"blank-corrected"* to account for measurement imprecision (Section 5.2.3). Specifically, given that the average DOC concentration

[2] To the best of our knowledge information published by the USGS on white sturgeon is accessible at the following websites: http://wfrc.usgs.gov/projects/9722DH2/5/publications.html and http://wa.water.usgs.gov/projects/roosevelt/publications.htm.

recorded in QA/QC samples (i.e., measurement blanks and laboratory controls [H2O]) was 1.93 mg/L, DOC concentrations for all treatment exposure chambers and sample types were *"blank corrected: by subtracting 1.93 mg/L from the measured DOC concentration"*. To ensure that measured DOC concentrations were not *""over-corrected"* (e.g., a negative value), *"blank-corrected"* concentrations were not allowed to fall below the average DOC concentration for U of S, ATRF laboratory testing waters of 1.50 mg/L." DOC blank values from a cursory view of the project database ranged from 0.64 to 3.73 mg/L (n=9). Relative to most sample results, the values and variation of blanks, combined with the relatively low number of sample (n=9; 1 blank per week) does not allow individual sample values to be corrected with any confidence (perhaps on the order of about ±3 mg/L; Page 5-7). The application of an average blank correction of 1.93 mg/L *"only to those values so as to not produce a DOC concentration that falls below the average for Teck testing waters (1.50 mg/L)"* is subjective and has no statistical basis. This approach may have resulted in overall estimates of DOC concentrations to be biased high relative to actual DOC values.

DOC blank data must be presented and discussed in more detail. In addition, the uncertainty in DOC measurements used for BLM modeling needs to be described more thoroughly by reporting the range of DOC concentrations that are likely (given the available blank contamination data) and by presenting the range of BLM calculated effect levels that can be determined within the reported range of DOC.

Comment Response. Reviewers may have misunderstood the nature of adjustments applied to DOC data. Text in Section 5.2.2.1 of the data summary report has been modified to clarify that DOC measurements were impacted by blank contamination and now reads "...a sizeable number of measured DOC concentrations were qualified as estimated values as a consequence of blank contamination." Summary statistics for reported DOC concentrations were subsequently adjusted (i.e. "blank corrected") to account for any reported blank contamination. The DOC samples in question were qualified with the "U*" flag, which signifies that this analyte should be considered "not-detected" because it was detected in an associated blank at a similar level. Thus, the entire purpose of the blank correction process was to adjust reported DOC levels to account for DOC presence in samples analyzed during the study.

DOC is believed to have been inadvertently introduced into samples at the time of collection during filtration. Filters used to process samples are believed to have been an unexpected source of DOC. To account for DOC introduced during filtration, a three-step blank correction process was used. First, DOC concentrations were adjusted by subtracting 1.93 mg/L from measured concentrations. Second, all adjusted DOC values less than a floor of 1.5 mg/L were reset to the floor value. Third, blank-corrected values were determined as the greater of either the adjusted DOC value or the 1.5 mg/L floor value.

The average and floor DOC concentration values used in the blank correction process are both well-defined and statistically-based. The average DOC concentration of 1.93 mg/L used in the first step of the blank correction process was determined from 185 samples with zero added DOC and included 9 measurement blanks and another 176 samples from the acute water-only exposures. The floor DOC concentration of 1.5 mg/L is a reasonable bound for DOC in water used for these sturgeon exposures and approximately represents the minimum organic carbon in unfiltered water measured in 59 laboratory samples collected during U of S 2009 sturgeon acute exposures (TAI 2011).

Further, the reviewer's statement that this approach "is subjective and has no statistical basis" is flawed for several reasons. One reason is that we know DOC samples were impacted by contamination during filtration such that reported DOC values are expected to be greater than true DOC levels. The blank correction process accounts for unexpected DOC in samples and nearly always yielded DOC estimates that were less than reported values. A second reason is that DOC concentrations cannot be negative. The use of a floor to prevent negative concentrations from being calculated is physically-based and yields blank-corrected values that do not imply that a negative mass was detected in a (non-zero) sample volume. A third reason is that the DOC floor concentration was based on measurements of U of S laboratory water. In this case, the DOC floor was approximately equal to the minimum measured value

such that blank corrected concentrations would not likely overestimate (or underestimate) true DOC levels. Given that this minimum was defined by nearly 60 samples, it is unlikely that DOC levels in U of S laboratory water would be much lower than the 1.5 mg/L floor value. It is also worth noting that the lowest measured DOC concentrations prior to blank correction (i.e., three samples ranging in concentration from 1.1 to 1.4 mg/L) were roughly equal to the floor value. Consequently, reviewer speculation that "[t]his approach may have resulted in overall estimates of DOC concentrations to be biased high relative to actual DOC values" is not supported by U of S data.

GC-8 It is not clear from the presentation whether equilibrium conditions were ever established in the tanks. For example, there is a high degree of variability in individual metal concentrations within these various water fractions inside individual exposure chambers during the course of the toxicity tests. Looking closer at the variability in SWIW metal concentrations - the likely exposure medium where a demersal species such as WS spends the majority of its time – we see that the 25th and 75th percentile concentrations of copper in SWIW from Deadman's Eddy (Figure 5-25) ranged from roughly 0.3 µg/L to 8 µg/L, with concentrations as high as approximately 30 µg/L (as measured with DGTs). Likewise, the 25th and 75th percentile zinc concentrations in Deadman's Eddy SWIW samples ranged from approximately 5 µ/L to 20 µg/L, with maximum reported concentrations of approximately 80 µg/L (Figure 5-27). These highly variable exposure concentrations could account for some of the observed survival and growth effects, or lack thereof. Toxicity testing under relatively consistent exposure conditions is critical to evaluating any potential effects from the sediment.

Comment Response. Comment acknowledged, please see response to GC-1. The purpose of this study was to examine whether the survival or growth of early life stages of sturgeon are impacted when reared on UCR sediments; it was not the purpose of this study was to normalize exposure concentrations. Different measures of exposure used during the study each provide a different view of the types of conditions sturgeon may experience during their early life stages. These exposure measurements include overlying water, sediment-water interface water, porewater at two different depths, and bulk sediment. To the extent that sturgeon fry swim in water above the bed, at or near the bed surface, or come into contact with sediment, they may experience highly variable exposures. Furthermore and as detailed within Section 5 of the data summary report, we would like to remind the reviewer that a number of statistical analyses were performed all of which confirmed that any difference were not due to the sediment but rather could largely be explained by seeding density and overlying water temperature.

GC-9 Much of the chemistry data from this study are qualified, there were deviations from the QAPP, and results are difficult to interpret due to fish losses and relatively poor control survival and growth. Add a section to the report that discusses lessons learned from this study that could improve data quality for any future investigations, and uncertainties (e.g., unequal/high stocking densities, DOC measurements, lowest survival and growth in controls, fewer available sediments than planned, exposures may not reflect a steady state condition, differences in metal speciation among water fractions, localized variations in porewater-sediment equilibrium due to air stone placements and sample collection, and the adequacy of sediment depth). Other specific sections could be referenced where issues are described in more detail.

Comment Response. TAI disagrees with the mischaracterization and apparent dismissal of study results by EPA and its project partners. The presence or absence of qualified data and/or deviations from the QAPP themselves do not, nor should they by default, call into question study results. For example, based on metals data collected throughout the duration of the study 45 percent of the data were qualified. Of the aforementioned qualified data, 99 percent had detection limits lower than their respective analytical concentration goals as defined within the EPA-approved QAPP. Therefore, regardless of being qualified the data can be used to help inform decisions (e.g., the concentrations are below respective risk based thresholds such as sediment toxicity benchmarks and chronic EPA water quality criterion). We would like remind EPA and its project partners that any and all deviations were clearly identified, approved, and are discussed within Section 3 of the report. Therefore, we disagree that results are difficult to interpret and have provided readers a fulsome presentation and discussion of the data to assist in this manner.

Furthermore, the purpose of a data summary report is to report the results and evaluate whether or not study objectives were met. It is not intended to present or discuss future investigations for which data quality objectives have not been defined. Therefore no edits to the document are required but trust researchers within the scientific community can and will use these data to help inform their potential studies.

GC-10 There are general conclusions in Sections 5 and 6 that are inappropriate or unsubstantiated given the narrow scope of the project *(e.g. "survival of white sturgeon was not adversely affected by exposure to Site sediments or substrates")*. These statements must be removed or qualified by stating that conclusions are limited to "laboratory test conditions" and for the "limited number of sediment samples collected".

Comment Response. The sentence that the reviewer is referring to in section 5.3.1(page 5-10) of the December 2012 data summary report is as follows (italics added for emphasis): "Therefore, *under the laboratory conditions evaluated herein*, survival of white sturgeon was not adversely affected when reared on Site sediments versus reference sediments." The caveat "*under the laboratory conditions evaluated herein*" is both an implicit assumption and an explicit statement in the text regarding interpretation of the results because this is a laboratory study. In Section 6 "(under laboratory controlled conditions)," is once again already in the text and the report addresses the range of concentrations of COPCs within the sediment samples collected. As such, the conclusions drawn are adequately substantiated, and no revision to the report is needed to address this comment.

GC 11 The conclusion that there are *"no significant data gaps"* (e.g., page B-22) is not supported by the study results. Remove this conclusion and discuss how the multiple deviations (Section 3.2), uncertainties (see General Comment 10), and ORD peer review questions (see General Comment 6) relate to data gaps.

Comment Response. The reviewers may have misunderstood the context of the assessment that no significant data gaps remain. The primary data gap that gives rise to this study, its design, and the data generated by it, was the need to obtain information to determine whether early life stages of white sturgeon reared on UCR sediment would experience adverse effects relative to sturgeon reared on reference sediments. This simple bioassay-related question was addressed and as such, fulfilled the objectives outlined within the EPA-approved QAPP. Furthermore, the data summary report clearly establishes that relative to the primary Study questions, no significant data gaps were identified that would require additional data collection at this time. Therefore, no significant data gaps were identified that would require additional white sturgeon toxicity testing prior to conducting baseline ecological risk assessment. During that time and consistent with Guidance (USEPA 1997), should EPA determine that there is insufficient information to support informed risk-based management decisions, additional data may be needed. Consequently, no revisions to the report are needed to address this comment.

EPA Comments on the UCR Draft Assessment of Sediment Toxicity to White Sturgeon Data Summary Report (December 2012)

Response to Specific Comments

ID	Section	Page	Comment to TAI	Response
1.	2.2	2-1, 2-2, 5-12	Section 2.1 introduces Deadman's Eddy as DME, in Section 2.2 it switches to DE, and is also defined as DE in Section 5.4. Pick one term and use it consistently.	As defined in the Acronyms and Abbreviations section xvii, DME refers to Deadman's Eddy and DE refers to substrates collected above the water line from the gravel bar at Deadman's Eddy. As such the terms are used correctly and consistently throughout the document and no edits are required.
2.	2.2	2-2	Include additional description in the methods section of the test acceptability criteria, including an explanation of the control survival rates (>64%) (see GC-3).	Performance criteria are discussed in Appendix A, Section 6. Performance criteria for control survival rates are specifically addressed in Appendix A, on pg. A-11 and in Table B-9 of Appendix A. Relisting all performance criteria in the text is redundant. Therefore, the following statement was added to the introductory paragraph of Section 2: "Details of study design and test acceptability criteria are in the QAPP, in Section 6 and Table B-9, respectively. The QAPP is included with this report as Appendix A for ease of reference." Further, we would like to remind the reviewer and as outlined within Section 5.3.1 on page 5-10 that "overall survival rates recorded for the Study were greater than performance criterion (≥64%) specified in the QAPP (TAI 2010a)."
3.	2.2 and throughout	2-2	Express measurements in metric units (e.g., not inches).	Comment acknowledged. Please note however that within the draft and draft final report both imperial and metric units of measure have been used (e.g., Section 2.4; pp. 2-4, footnote number 4, Section 2.5; pp. 2-5 etc.). Exceptions include instances where the EPA-approved QAPP only specified imperial units (e.g., 5-gallon buckets), or where sampling devices incorporate imperial units of measure as part of the product (e.g., 6-inch micro-bubblers). As a result, to maintain continuity with the EPA-approved QAPP and not modify product Trademarks it would be inappropriate to convert these to metric units of measure. Therefore we appreciate the comment and wish to confirm that units of measure have been appropriately assigned within the report to accommodate both imperial and metric preferences; while still maintaining continuity with the EPA-approved QAPP and sampling equipment.
4.	2.2	2-2	Additional details summarizing the methods are needed to clarify how exposure chamber designs in the QAPP were implemented in the study. Include a Figure illustrating the final design of test chambers (similar to the prototype shown in the QAPP) with placement of pore water sampling devices. Also describe the formulation of source water and how it was recirculated over the sediment.	Comment acknowledged. We wish to confirm that details associated with study design (i.e., implementation of exposure chambers) are presented within the report. Any and all deviations encountered during the course of completing the work are discussed in Section 3, with signed deviation / corrective action reports included in Appendix E. This includes the placement of "porewater sampling devices", refer to page 3-3 (i.e., Deviation Report Nos. 01 and 11). Unless discussed in Section 3 of the report, there are no deviations associated with the Study including exposure chamber design. As a result, reviewers are encouraged to review the additional details regarding exposure design and recirculation procedures/rates within Appendix A (e.g., SOP-13). Furthermore, reviewers are reminded that a significant level of effort in finalizing the exposure chamber design, including flow and recirculation rates, was completed during Methods Development work. Findings of this work were used in the final design and are reflected in the EPA-approved QAPP. We appreciate the suggestion to include a schematic (figure), however we do not believe this would serve to clarify or provide any additional details above those already made available. However, we wish to confirm that an Appendix of photographs (Appendix D) has been included to illustrate actual exposure conditions, methodologies, and chambers used throughout the Study. We trust that the inclusion of such photographs better illustrate actual Study conditions and provide reviewers a better picture. We also would like to remind reviewers that the formulation of test waters has been described within the report (e.g., see page 2-3) and that detailed discussions of source waters can be found in Appendix A (e.g., SOP- #9000).
5.	2.2	Page 2-3; Table 2-3	Table 2-3 indicates that "0" chemistry-only replicates were prepared for "DE" sediment, which seems to contradict figures which show pore-water metals concentrations from DGT and peepers (1-cm) for "DE" sediment. Please clarify these data presentations. A footnote could be added to the tables to reiterate any needed explanations.	Comment acknowledged. We wish to confirm that Table 2-3 has been corrected to accurately reflect Deviation No. 04 in which "DE" substrates were used to develop 2 biological and 1 chemistry only chamber for the Study. We wish to confirm that data presented within all subsequent tables and figures are correct.

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6.	2.3	2-3	Change "...*eggs from two female and two male adult white sturgeon*..." to "...*eggs from two female and sperm from two male adult white sturgeon*..."	Comment acknowledged. We wish to confirm that the suggested edit has been made as requested.
7.	2.3	2-3	Describe how egg hatchability in the lab water controls compared with those observed at the Kootenay Trout Hatchery for the fish from the same fertilization event (see GC-3).	Comment acknowledged. Please refer to comment response provide in GC-3.
8.	2.3	2-3	There is a lack of detail on all aspects of the fish husbandry that could have an effect on growth rates, growth conditions, and general fish health. Describe the culture tanks (i.e., flows) and conditions that were maintained to support white sturgeon hatching, growth, and development. Comment, or include as an uncertainty, aspects of the fish culturing that could have contributed to low survival during the transition to exogenous feeding or otherwise affected test data.	We respectfully disagree with the reviewer that aspects of fish husbandry were not documented. These fish were extensively monitored and all parameters of fish husbandry documented as part of test conditions. To more specifically answer some of the reviewers questions; information on hatching conditions are listed in Section 2.3. As discussed within the Section fertilized sturgeon eggs were incubated in hatching jars under gentle flow conditions until hatch. Over the first 72 hrs (until neurulation occurs) water flow was adjusted such that eggs were only rolling very gently at the bottom of the jar to ensure no disruption of neurulation. Once neurulation was completed water flow was increased such that eggs were vigorously agitated and were circulated in the bottom third of the hatching jar to avoid fungal infection. Flow rates were adjusted based on visual assessment to the above conditions as this provides a more accurate way of obtaining optimum agitation of eggs than pre-set flow rates. After hatch, embryos were kept in insulated green holding tanks under constant flow-through conditions until seeding into test chambers. Any potential uncertainty associated fish husbandry is addressed by the EPA ORD peer review, therefore no additional edits are required. The reviewer is also reminded that this is a data summary report.
9.	2.3	2-4	The rationale for WS stocking density should be further described as the final fish density is concluded to have influenced the growth endpoints. For example, refer to lessons learned from earlier research on WS toxicity testing as described in Vardy et al. (2011). Effects of subchronic exposures of early life stages of white sturgeon, (*Acipenser transmontanus*) to Cu, Cd and Zn. ET&C. 30(11):2497-2505) may be helpful.	Comment acknowledged. The reviewer is reminded that the rationale for stocking density was specifically discussed during the development of the QAPP, please refer to Appendix A. As stated on pp. B-5 of the EPA-approved QAPP, fish densities for specific life-stages during the exposure period were calculated based on optimum seeding densities for this species under fluvial conditions as determined by Tompsett et al. (2013; recently conditionally accepted in the *Ecotoxicology & Environment Safety*). Based on previous work by Vardy et al. (2011) and the above-mentioned conditionally accepted study in *Ecotoxicology & Environmental Safety* by Tompsett et al. (2013), both studies identified a significant and positive correlation between seeding density and mortality. It has been hypothesized that this mortality was associated with a number of factors including limited grazing surface and inter-individual competition. Recommendations made in Tompsett et al. (2013) based on previous study designs were as follows: Recommended stocking density = 86 fish × 0.049 g/fish (@ termination of study)/40 L/chamber = 0.11 g/L. Therefore the recommended surface area = 5000 cm^2 / 86 fish = 58 cm^2/fish. Test chambers utilized in this study were 4× greater in size, and habitat was enriched (i.e., adding gravel) consistent with the EPA-approved QAPP, increasing surface area for grazing and potentially reducing inter-individual competition. Based on the above recommendations, calculated mass per volume and surface area for the sediment toxicity study were intended to be below the recommended values. However and as documented in the deviations of the report, as a consequence of fish replacement and re-seeding, the initial density of sturgeon fry differed from target values. To account for differences in fish densities, Kaplan-Meier survival analysis was performed, consistent with ORD Peer Review recommendations. ANOVA and ANCOVA analyses were used to evaluate the influence that seeding density had on growth.

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ID	Section	Page	Comment to TAI	Response
10.	2.3	2-4; Table 2-4	Describe the number of fish added to each exposure tank in the first 48-hrs in Table 2-4 (i.e., 100 fish at T-0; XX fish on day 1 to replace lost fish). Discuss how the number of fish seeded agrees with the number of fish determined from survival and mortality counts.	As noted in Section 2.3, obtaining an accurate tally of fish was made difficult by lost/escaping fish (e.g., an uncertainty in the number of sturgeon fry completely flushed from exposure chambers). This was immediately recognized and acknowledged within deviation/corrective action report No. 08, where re-seeding efforts may result in differences in starting densities, but that these differences can be accounted for at the end of the Study. This is clearly reflected in Table 2-4, where the number of fish seeded was ultimately determined by summing the number of counted mortalities during the course of the entire study, plus the number of lost/escaped fish, plus the number of survivors at the end of the study. As indicated by the data, for certain exposures (i.e., H2O, controls) the average seeding density was greater than anticipated. Although the loss of organisms by escaping is not ideal, it is certainly not unique to sturgeon testing as acknowledged by the ORD-peer reviewers. Survivor estimation models like Kaplan-Meyer (employed for this study) have been developed to deal with and accommodate such circumstances; and were employed in the report consistent with recommendations following the ORD peer review.
11.	2.3	2-4	Discuss how the feeding regime described in the QAPP (Table B-7) was followed or explain why, if not. Include a description of the feeding rates and how they compare with those described in the QAPP, the food source (and species) of "blood worms" and "oligochaetes", the nutritional quality of food items, and the rationale for selecting these food items (see GC-6b).	There was no deviation from the QAPP in the feeding regime. As noted within the EPA-approved food was to be provided *ad libitum*. In short, feeding was initiated approximately three to four days prior to swim up and occurred every 4-8 hours throughout the day and night. The reviewer is reminded that feeding with oligochaetes was not performed in this Study but rather, it is our understanding, was a food source in the parallel USGS work being completed for EPA. The reviewer is reminded that the rationale for food sources are provided and discussed within the EPA-approved QAPP, refer to Appendix A of the report. Therefore no changes are required in the text.
12.	2.3	2-4	Provide data documenting WS loading densities in chronic and acute exposures and discuss how test conditions agreed or disagreed with those described in the QAPP (i.e., density/rate of 0.1 g/L/24 hours to 0.5 g/L/24 hours).	Comment acknowledged. We would like to remind the reviewer that data associated with the Study are available and accessible from the project database (http://teck-ucr.exponent.com); and consistent with other data summary reports are enclosed (compact disc) within the report. Based on this data, fish loading densities specified in the EPA-approved QAPP for the sediment exposures were dynamic loading densities and were targeted to be 0.1 g per (L/24 hr). At test initiation, flow through each tank was 250 L/day and the average dynamic loading density was 0.014 g/(L/24 hr). At test termination, flow through each tank was 375 L/day and dynamic loadings averaged 0.12 g/(L/24 hr); with an observed range of 0.035 to 0.15 g/(L/24 hr). Loading densities were always appreciably less than the maximum value of 0.5 g/(L/24 hr) identified in the applicable ASTM standard.
13.	2.4	2-4	A DQO for this study (QAPP; Section A7.2) was to assess "*...the potential toxicity of granulated slag COPCs in UCR matrices to white sturgeon ELS*." Describe how slag was assessed in this study and present these data, or explain why slag was not assessed.	Comment acknowledged and the reviewer is correct in that a study objective was to assess the potential toxicity of **COPCs** associated with granulated slag in UCR sediments. As identified within the EPA-approved QAPP, **COPCs** associated with granulated slag include: cadmium, copper, lead, and zinc. This is clearly captured and communicated within the QAPP (see Maps A-2 and A-3 of the QAPP). Based on sediment data collected within this Study (refer to Appendix F, formerly E) it is very clear that COPCs associated with granulated slag were measured and evaluated. Therefore and as noted within the report satisfying study objectives. The reviewer has apparently and inappropriately equated slag to be a COPC. Slag itself is not a COPC and as such, no edits to the report are required.
14.	2.4 and 2.5	2-4 to 2-7	Sections 2.4 and 2.5 summarize sampling methods for water and sediment. Add a table describing the types of samples collected from each of the chemistry replicates or from each of the biological replicates and when they were collected.	Comment acknowledged. We would like to remind the reviewer that over 50,000 samples and associated analyses were collected during the course of this Study. Details associated with each sample (e.g., sample type, sample date, sampling method, sample chamber etc...) are all available via the project database (http://teck-ucr.exponent.com). We do not believe placing this volume (e.g., 50,000 rows) of information within a table would add any value to the report, and given the large volume of data has the potential for transcription errors. Therefore no changes to the text were made and we encourage the reviewer to access data using the project database.

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ID	Section	Page	Comment to TAI	Response
15.	2.4 and 2.5	Tables 2-5 and 2-7	Highlight in Tables 2-5 and 2-7 and explain any MDL or MRL ranges that vary by more than a factor of 10. Also add a column indicating the target MRL.	Tables 2-5 and 2-7 have been updated as requested. Text already exists in Section 4 of the data summary report explaining the results of data validation which identify various reasons why MRLs or MDLs are affected. Please refer to the response to general comment 9 for more information about data quality.
16.	2.6	2-7	Clarify in the methods (Section 2.2) that exposures were not actually 60-days as per the QAPP (Table B-6) because fish were euthanized on two separate days (stated on page 2-7). Also clarify in the results section which replicates were sampled on each of these two separate dates to end the exposures.	Table B-6 of the QAPP does not list requirements for days of exposure. However, Table B-8 of the QAPP identifies Day 59 as the day to "terminate the study" and "euthanize fish in MS222." Additionally, there is a footnote at the end of QAPP Table B-8 which states that "actual days listed here are approximate." Throughout the QAPP and the DSR there is no mention that exposures would be 60 days but instead the "total test duration extended for 60 days" (Section 2-3 of the revised DSR). Exposures were conducted from 1 day post hatch (when fry were placed in chambers) through 60 days post hatch. Tests were terminated starting when fish were 60 days post hatch and continued over a roughly 24-hour period until end of study procedures were completed for all chambers.
17.	2.4-2.6	2-4	Add a section to the methods describing data analyses (e.g., statistical methods, BLM description).	Comment acknowledged. It is important to note that Section 2 Study Design and Sampling Methods is not about nor intended to be a discussion of data analysis, such information is discussed in detail within Section 5 of the report and are appropriately identified and described (e.g., Kaplan-Meier, Dunnett's test etc...). This approach is consistent with data summary reports prepared, submitted, and approved by EPA for the Remedial Investigation/Feasibility Study to date and as such, no edits are required for this section of the report. Please refer to response to specific comments 66, 67, 73, 74, and 75 relative to the Biotic Ligand Model and its application within the report.
18.	3.1	3-2, 2nd paragraph	The report concluded that ammonia or nitrite may have been approaching toxic concentrations in overlying water in some of the treatments and was the basis for a decision to increase overlying water flow rates. However, it appears that concentrations of both ammonia and nitrite were quite low in the overlying water in all of the replicate exposures (Figures 5-14 and 5-16). Include a reference and describe these toxicity thresholds.	The QAPP (Appendix A) specified that all water quality parameters with the exception of DO and temperature should not vary by more than 50%, see Table B-10 of the QAPP. Given that ammonia levels in tanks without fish were measured during the preliminary studies to be approximately 0.04 mg/L, consistent with the QAPP the goal was to maintain ammonia concentrations less than 0.06 mg/L. The reviewer is correct that absolute concentrations of ammonia remained quite low but as indicated within the report and associated change order request, there was a trend of increasing ammonia and nitrate concentrations. As such, for consistency with the QAPP and to ensure that these data would not confound study results a change order was submitted and approved by EPA. The aforementioned increasing trends are now more apparent that the figures have been redrawn with a larger scale on the y-axis. The reviewer's note regarding the use of language that would imply potential toxicity in consideration of such low concentrations is understood. As a result, to help improve clarity the sentence has been revised to read: "To ensure that inorganic nitrogen concentrations did not approach levels that could adversely affect study results, it was recommended that water flow-through rates be increased from 250 L/day to 375 L/day."
19.	3.1	3-2	Clarify and/or explain inconsistencies in the text describing water flow that was increased from 250 L/day to 375 L/day (Section 3.1) with the statement on Page 2-2 (last paragraph) that the flow rate to each replicate was 20 L/minute. Note that if flow/chamber was 20 L/minute x 60 minutes x 42 replicates x 24 hours = more than 1.2 million L/day (likely an error for the reported flow rate on Page 2-2). If the flow rate is 250 L/day/chamber (or 0.173 L/minute) x 42 chambers = 10,500 L/day (statement on Page 3-2 seems more reasonable for the flow rate to each replicate chamber).	Section 3-1 describes the Change Requests, which includes increased flow rates to compensate for increased ammonia (see previous comment). As such, there is no inconsistency with Section 2-2 where the initial study design was described as having "a flow of approximately 20 L/min." However, the Reviewer's point that a flow rate of 20 L/min would result in 1.2 million L/day is well taken. A flow rate of 250 L/day is equivalent to 0.17 L/min (approximately 0.2 L/min). The text in Section 2.2 and Section 3.2 has been edited to read 0.2 L/min.
20.	3.3	3-5	While a summary of the ORD peer review comments is helpful, listing the charge is of limited utility in the middle of this report. Move the charge questions to accompany the ORD peer review report in Appendix D.	Comment acknowledged. We appreciate the comment and wish to confirm that Appendix D contains the entire EPA Peer Review Report, including the Charge Questions. We disagree with the comment however as the charge questions within this section of the report provide the necessary context for the reader, and as such do provide utility. Therefore no change to the report is warranted.

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21.	3.3	3-5	Clarify which "Study" this sentence refers: "*At EPA's request, the ORD conducted an internal peer review of that Study and work completed by the USGS, CERC.*" It is also sufficient to limit the discussion of ORD peer review comments to those made on TAI's sediment toxicity to sturgeon study.	Comment acknowledged. We wish to confirm that the sentence has been updated to read: "At EPA's request, the ORD conducted an internal peer review of this Study and work completed by the USGS, CERC." Although we appreciate the suggestion of limiting the discussion of ORD peer review comments to work completed at the University of Saskatchewan, that would not be accurate of what was requested of and completed by the ORD peer review team. As such and for consistency with peer review comments (provided in Appendix E [formerly Appendix D]) the remaining portion of the sentence was not modified.
22.	4	-	There is a rather high incidence of out of range and estimated analytical results. Present the specific number of samples per parameter with out-of-range or qualified values, a summary of the range of reported values for these data, and the planned MRLs. Also discuss the overall analytical performance for this study to aid interpretation of these data. Any lessons learned should be discussed (see GC-9)	Identification of the values that exceed MDLs and MRLs are in revised Tables 2-5 and 2-7 (see response to SC-15). See also response to comment GC-9 for information on overall analytical performance for this study.
23.	4.1, 4.2.2, 4.3.3, 4.3.4, and elsewhere	-	Present the number of samples and percentage of samples when discussing data. For example, each of the three bullets in Section 4.1 must provide the total number of samples in each group discussed. ("*910 sediment data points*" of how many?). In sections 4.2 and 4.3, clarify what is meant by "*Most samples …*" The terms "many", "several", etc. should not appear in the results.	Comment acknowledged. Section 4.1 of the revised data summary report now presents number of samples and percentage of samples in discussions about data usability. Use of the term "several" in Sections 4.2 through 4.6 of the data summary report is consistent with language in other data summary reports that have been finalized and approved by EPA. If the reader wishes to obtain further information on number of samples that were qualified for various reasons all validation reports for this study can be found on the "Downloads" tab of the project database at http://teck-ucr.exponent.com.
24.	4.1	4-1	Provide additional information about the referenced project database, such as the URL and contact information to access these data (i.e., TAI-Exponent or EPA).	The information requested by the reviewer is provided in the introduction to Section 4 (Validation Assessment) and the URL (http://teck-ucr.exponent.com) is provided in the last sentence of Section 4.1.
25.	4	Table 4-1	There is reference to a "*case narrative*" in the legend of Table 4-1 but no discussion of outliers was found in the main text. Provide a description of the information in the "case narrative" that is referenced in Table 4-1 and include the section and page number of the laboratory report where it can be found in the table legend reference. Also explain why 5.5% of sediment Zn results were flagged as outliers, when the sediment sampled for this study is known to have extremely high levels of Zn. Any lessons learned from this analysis should be discussed (see GC-9).	Each CAS laboratory report includes a case narrative at the beginning of the report which is referred to in the "data qualifier" section of each report where applicable. All of the above-referenced CAS lab reports available in the project database (http://teck-ucr.exponent.com). Because the case narrative differs for each of the qualified data, and at times may be lengthy, it is not practical to include this information in the data table; however information found in case narratives is used by the data validators and results are summarized in Section 4 of the data summary report. In response to the reviewers comment regarding 5.5% of sediment Zn results flagged as outliers, this specifically refers to one batch of 17 samples in CAS laboratory package K1010718 (also referred to as lab_pkg in the project database) in which the Zn results were flagged by the laboratory with a " * " qualifier defined by CAS as "The result is an outlier. See case narrative." The case narrative states "The Relative Percent Difference (RPD) for the replicate analysis of Aluminum and Zinc in Sample CRTL-C was outside the normal CAS control limits (63% and 32% RPDs respectively, versus a control limit of 30%). The variability in the results was attributed to the heterogeneous character of the sample. Standard mixing techniques were used, but were not sufficient for complete homogenization of this sample."
26.	4.1	Tables 4-1 and 4-2	For the majority of analytes listed in Table 4-1 and for several analytes listed in Table 4-2, the value in the "*Count of Results with No Flags*" column is greater, often by a factor of 5 to 10, than the value listed in the "*Accepted Results*" column. Explain how this is possible along with an explanation of the column headings. Currently it is unclear to what the column "*Count of Results with No Flags*" refers. The reader could assume that it is the "*Number of Samples Analyzed*" minus the sum of "*Count of Accepted Results Laboratory Flags*" or the "*Number of Samples Analyzed*" minus the sum of "*Count of Accepted Results Validator (ESI) Flags.*" Neither of these appears to be the case.	Tables 4-1 and 4-2 have been updated. The "Number of Samples Analyzed" is now always equal to the sum of the columns "Reject Results" and "Accepted Results." The "Count of Results with No Flags" refers only to accepted samples. The flags qualify the "accepted" samples as defined by the footnotes.

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27.	4.1 and 4.2.1	4-1 to 4-3, Table 4-2	Table 4-2 indicates that "100%" of DOC results were deemed acceptable based on laboratory review, yet 23% were flagged by U*, meaning results were reported as non-detected because "blank contamination compromised data interpretability". Similarly, 67%, 51%, 75%, and 75% of the results for Cd, Cu, Pb, and Zn in water, respectively, were evidently flagged as U*. These four metals and DOC are important parameters in the study. Provide additional discussion regarding what type of samples (e.g., overlying water, or pore water by peeper, DGT, suction), as well as which sediments and/or dates (if applicable), were most affected. Also discuss the possible causes of this extensive blank contamination, lessons learned, and influence of these qualifiers on data interpretation (see GC-9).	Comment acknowledged. It is unclear what the reviewer is quoting from Table 4-2. As noted within the note to Table 4-2, U* is defined as "This analyte should be considered "not-detected" because it was detected in an associated blank at a similar level", not what has been cited by the reviewer. As noted within the report, non-detect data have been appropriately considered within the analysis using the Maximum Likelihood Estimation (MLE) method and as such, do not adversely affect data interpretation. Samples with the greatest proportion of U* qualifiers were associated with non-standard sampling methods (i.e., DGTs). As a result, and consistent with findings associated with Methods Development work, using DGT-metal measurements to characterize metal bioavailability and exposure levels in sediments, and the potential for effects, is uncertain. However, given that additional techniques were employed throughout the duration of the Study, there are more than enough data to adequately characterize exposures during this Study. No edits are required in the document and the reviewer is referred to response to general comment (GC-9) for additional detail.
28.	4.1	4-1; Table 4-3	The second sentence states that "*Only useable data were included in this report, although all rejected data are in the project database*." Table 4-3 lists the rejected samples and analytes. Clarify that only useable data are shown in the tables, figures, etc and refer to Table 4-3 here as a list of the rejected samples.	Comment acknowledged. Text in Section 4 has been updated as follows "Only useable data were included in analyses and presented in figures, although all rejected data are in the project database and are listed in Tables 4-3 and 4-4."
29.	4.1	4-2	Rejecting 1,014 data points (<12 percent) seems to be a high percentage of all the data. Provide additional discussion on the possible causes of this extensive blank contamination, lessons learned, and influence of these qualifiers on data interpretation (see GC-9).	Comment acknowledged. We appreciate the comment and wish to confirm that in reviewing the overall program data we discovered an error in our calculation of percentage of data points rejected. In fact there were 1,014 data points rejected out of 50,698 analyses performed for the study. This represents only 2 percent of the data points rejected. The text in Section 4.1 has been revised to correct the information.
30.	4.1	4-2	The first bullet states that "*Results for all organochlorine pesticide compounds, PCB congeners, and PAH compounds in 910 sediment data points were qualified as unusable due to exceeded sample preservation temperatures*." However, sections 4.4 through 4.6 describe organochlorine pesticide, PCB and PAH data as usable. Clarify this inconsistency.	The bullet point clearly explains that 910 data points were unusable with the rest of samples discussed in Sections 4.4 and 4.6 being usable, as such there is no inconsistency. However, we have removed the word "all" in order to address the reviewers' concern and clarify the statement.
31.	4.2	4-2	Clarify the statements that ""*According to Table B-3 of the QAPP, aqueous samples for metals analysis should be preserved to a pH < 2 su. As a result, there was insufficient information for ESI to verify that the affected samples were properly preserved; and data were not qualified due to this issue*." Indicate why ESI did not qualify data for which proper storage pH could not be verified. It would be helpful to describe why volumes were limited in these instances and indicate if SOPs for metal sample preservation were followed (as indicted in the sentence preceding the quoted passage) and the likelihood that the target pH was obtained with by following the SOP and verification of pH in the other samples. The issue could also be included as an uncertainty (see GC-9).	Text in Section 4.2 of the DSR has been revised to clarify why ESI did not qualify data for which proper storage pH could not be verified. The text in the second paragraph now reads: "According to Table B-3 of the QAPP, aqueous samples for metals analysis should be preserved to a pH < 2 su. When samples were received by the CAS laboratory the standard operating procedure (i.e., SOP SMO-GEN Sample Receiving) was followed and information documented on the CAS Cooler Receipt and Preservation Form for each SDG. The SOP required CAS to check the above referenced samples for the appropriate pH (i.e., < 2 su) by pouring a small aliquot of sample from the sample container and measuring pH of that aliquot. In approximately 75 percent (610) of the 810 above referenced aqueous samples, CAS did not check for the appropriate pH due to limited sample volumes (e.g., in some cases 5 mL, of the required minimum sample volume of 15 to 20 mL to conduct metals analyses listed in Table B-3 of the QAPP). This allowed for conservation of sample volume to perform as many analyses as could be performed. However, in approximately 25 percent (200) of the aqueous samples, sample volume was not an issue and CAS was able to check pH and verify that the samples were in fact preserved properly (i.e., pH < 2 su). As a result, although ESI was unable to verify that 75 percent of the aqueous samples were properly preserved, they did not qualify the metals data for these samples based on the reasonable assumption that the sampling technicians followed preservation requirements for metals analyses in Table B-3 of the QAPP as was verified by CAS lab when 200 aqueous samples checked were preserved properly."
32.	4.2.1	4-3	Present concentration ranges for the analytes listed as "*non-detect due to the presence of similar concentrations in rinse blanks*."	Please see response to specific comment 27.

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33.	4.2.2	4-3	Explain how and why laboratory holding times were exceeded.	Holding times were exceeded as described in Section 4.2.2 because samples were delayed during border inspections when being shipped from the University of Saskatchewan to CAS laboratory in Kelso, Washington. This explanation was added to the revised report to clarify.
34.	5.1	5-1, third paragraph; Figures 5-1 through 5-4	Provide references/sources for the data used to determine the distribution of metals in the historical samples described here and in Figures 5-1 through 5-4.	Comment acknowledged. Text referencing Figures 5-1 through 5-4, clearly indicates that the "historical samples" refer to data collected within the Site. Nevertheless to improve upon clarity the third paragraph of Section 5.1 has been modified as follows: "As indicated within Figures 5-1 through 5-4, sediment concentrations of cadmium, copper, lead, and zinc in samples collected for this Study span the distribution of values observed in historical samples obtained at the Site (historical data are available in the UCR database at http://teck-ucr.exponent.com)."
35.	5.1	5-1, third paragraph;	The text states that sediment metal concentrations routinely exceed the 90th percentile of historic UCR samples, however Cd has no values over the 90th percentile. Clarify this discussion to reflect that none of the three UCR site sediments evaluated in the current study had concentrations of Cd above about the 70th percentile of previously reported UCR sediments.	Comment acknowledged. The following text has been added to the third paragraph of Section 5.1 to address the reviewers concerns "...the one exception was Cd, whose values were less than the 75th percentile."
36.	5.1	5-1	It is an overstatement given the very limited number of samples that "*Based on these results, sediments evaluated for this Study appear representative and consistent of the range of concentrations observed with Site sediments*". Remove or qualify this statement (see GC-10).	We disagree with the reviewers' comment, please see response to GC #1. The key is not the number of samples but whether or not the samples represent and reflect sediment concentrations in the field. As such, no edit to the document is needed.
37.	5.1	5-1; Fourth paragraph, first sentence	Clarify that the following sentence "...*exceeded respective threshold and probable effect concentrations*." refers to sediment TECs and PECs.	Comment acknowledged. We wish to confirm that the sentence clearly specifies that the discussion is associated with sediments. Specifically, the sentence reads as follows: "In addition (also illustrated within Figures 5-1 through 5-4), Site sediment concentrations in this Study consistently exceeded respective threshold and probable effect concentrations (MacDonald et al. 2000)." As indicated by the above, it is very clear that this discussion is associated with "Site **sediment** concentrations". Furthermore, the section header is titled "Section 5.1 SEDIMENTS". Therefore no edits are required.
38.	5.1	5-1	Long *et al.* (1998) should not be cited as a source of TECs or PECs.	Comment acknowledged. The suggested edit has been made, please refer to response to specific comment 37 to verify the edit.
39.	5.1	5-1	Please clarify why TECs are referenced when there are no data summaries provided in the report relative to exceedances of TECs and Figures 5-1 through 5-4 only refer to PECs.	Comment acknowledged. Reference to TECs are made because Figures 5-1 through 5-4 provide a summary comparison of sediment concentrations relative to respective TECs. As noted within Figures 5-1 through 5-4: "The 90th percentile...while a dashed line and a solid black line are used to identify the probable effect concentration and threshold effect concentration, respectively." Therefore no edits to the report are required.
40.	5.1	5-2	Define the units "gd"	Comment acknowledged. We wish to confirm that all units of measure have been defined and can be found listed on Page xxi of the report. As noted within the "Units of Measure" summary "gd" and as employed within the text in question is a component of the overall unit of measure µmol/gd = micromoles per gram dry weight.

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41.	5.1	5-2 to 5-3	Clarify the discussion of bioavailability that suggest an association between excess ΣSEM values >3000 µmol/gOC and effects to WS even though this toxicity metric was developed for predicting the potential for toxicity to benthic macroinvertebrates.	Comment acknowledged. The AVS:SEM framework much like the approach using TEC and PEC values was developed based on consideration of potential risks to benthic invertebrates. This is clearly identified in the preceding paragraph which states: "In addition to whole sediment concentrations, EPA recognizes the utility of AVS and SEM for characterizing the potential toxicity of sediments contaminated with metals as part of the equilibrium sediment partitioning benchmark approach (USEPA 2005). As with the above mPECQ calculations, although the principles associated with AVS and SEM were not necessarily developed to evaluate potential effects on demersal fish species such as white sturgeon, the data and associated analyses presented below provides a measure of bioavailability of metals associated with sediments. As a result, is used to assess the range and gradient of potential effects based on principles of bioavailability." Therefore, the principles associated with AVS:SEM remain valid and provide additional information to help explain the results which is ultimately integrated by the test species (in this case a demersal fish; white sturgeon). Therefore no edits are required to the document.
42.	5.1	5-3	The report should advise further caution in interpreting the potential for toxicity to fish based on SEM-AVS in UCR sediments where the TOC is quite low (<0.1%). Low TOC will exaggerate the bioavailable fraction when normalizing SEM-AVS to organic carbon. The TOC data for each sediment sample should be provided in Table 5-1 to support this discussion.	Comment acknowledged. The text is very clear as to the procedures and potential limitations associated with the use and application of AVS:SEM, not only for this study but in general. Therefore there is no need to edit the text or to speculate on an area outside the scope of the Study. We would like to remind the reviewer that like bulk sediment concentrations, AVS:SEM measurements and total organic carbon concentrations are data intended to help decrease uncertainty, and as stated in Section 5.1 of the report "...sediments evaluated in this Study have carbon normalized excess ΣSEM values >3000 µmol/gOC, and therefore effects from metals cannot be ruled out on the basis of AVS values alone. In these cases, sediment guidelines recommend further study (USEPA 2005), such as the biological and chemical evaluation of effects on white sturgeon as detailed herein." We wish to confirm that Table 5-1 has been updated to include total organic concentrations as measured in the sediments.
43.	5.1	Figures 5-1 to 5-4	Add four frequency distribution figures (similar to Figures 5-1 through 5-4) for (As, Cr, Ni and Hg) so that bulk metal concentrations are presented for all metals that are used in Figure 5-5 to calculate mean probably effect concentration quotients.	Comment acknowledged. Please note however that frequency distribution curves for all inorganic (e.g., As, Cr, Ni, Hg etc...) and organic sediment analyses were presented and are available in Appendix F (formerly E) titled "Sediment Data Distribution Plots for White Sturgeon Toxicity Testing". Therefore no edits are required.
44.	5.1	Figures 5-1 to 5-7	Expand the legend to describe all lines and symbols, including "<" and "E" in Figure 5-6. Note that sample types that do not appear in the figures are listed in the legend for Figures 5-6 and 5-7.	Comment acknowledged. The following note has been added to Figure 5-6: "Concentrations identified as being below detection limits are illustrated with a less than symbol ("<") and are plotted at the detection limit. Concentrations identified as "estimated" are illustrated with an ("E") and are plotted at the estimated value." Please note that sample types listed in the legend for Figures 5-6 and 5-7 do appear and are appropriate as indicated by the number of samples. As such no edits are required.
45.	5.1	5-1 and Figure 5-22	The box and whisker plots illustrating the distribution of data do not seem to represent the data very well in some instances. For example, the Cd concentration in the 2.5 cm porewater in station LMF (Figure 5-22) illustrates nearly all of the observations above the median. The notes indicates that the "<" character was used for non-detects but none are apparent in these figures. Correct these inconsistencies or explain them.	Comment acknowledged. The summary plots provide an accurate representation of the data. As discussed in Section 5.2.2.2 of the report, non-detectable concentrations (although plotted at the detection limit) have true concentrations that lay between zero and the detection limit. Therefore to better represent data distributions a maximum likelihood estimate (MLE) procedure, which considers the presence of non-detectable concentrations when estimating the mean, median, and variance for a given dataset, was employed. A detailed description of the MLE procedure employed is provided in Appendix G (formerly F) which is titled "Estimating Summary Statistics for Datasets that include Below Detection Limit Values." In consideration of the detailed explanation outlined within the aforementioned appendix there are no inconsistencies and no edits are required.
46.	5.1	Figures 5-1 through 5-5	Figures 5-1 though 5-5 need to be expanded and the circles/squares made smaller so most, if not all, of the data points can be distinguished.	Comment acknowledged. The reviewer's concerns have been addressed by redrafting the figures with a shorter y-axes so the data separation are seen more clearly.

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47.	5.1	5-1; Figures 5-5 to 5-7	The samples collected during the study are limited and should not be presented as being adequately representative of the range of chemical or toxic conditions found in UCR sediments. Include cumulative frequency distribution plots for mPECQ and ∑SEM-AVS, and (∑SEM-AVS)/foc showing the sample data for this study in relation to historic sediment samples from the UCR.	We disagree with the reviewers first half of the comment, please see response to General Comment #1. With respect to the second part of the comment we wish to confirm that the requested cumulative frequency distribution plots have been included as part of Appendix F (formerly E) in the revised report.
48.	5.1	Figures 5-6 and 5-7	Genelle data appear to be missing and LALL points are all > 3000. Add Genelle reference site data to Figures 5-6 and 5-7.	See response to Specific Comment #44; the data in question screen out because excess SEM is <0.1 µmol/gd.
49.	5.2		There are numerous qualitative statements comparing chemical data with terms such as "*good agreement*", "*similar medians*", "*comparable*", "*Differences...appeared to be small...*" Such comparisons have little meaning due to the poor data quality. Delete these comparative statements.	We disagree with the reviewers mischaracterization of data quality but respect their opinion. Therefore, where practical, we have reduced the use of qualitative descriptors. Please note however that we believe data summary reports are intended to present descriptions of study results along with basic statistics. Limited use of qualitative descriptors (e.g., statements such as "similar means", "good agreement", etc.) is standard scientific practice and completely appropriate within a data summary report. We would also like to point out that unlike other recent studies involving white sturgeon, this study achieved its performance criteria and met its DQOs.
50.	5.2.1	Table 5-2; Figure 5-9	The report concluded that, on average, daily temperature was about 15.5 °C with instantaneous temperature within 3 °C of 15 °C (Page 5-3). However, this goal (i.e., average daily temperature should be maintained at 15 ± 1 °C; the instantaneous temperature must always be within ± 3 °C of 15 °C) may not have been met in each replicate exposure. For example, Figure 5-9 illustrates that temperatures were consistently different among some replicates within a treatment by at least 2 °C.	Variations in temperature were within ± 3 °C, which is a slight exceedance of the target average temperature (15 ± 1 °C; see Table B-7 of the QAPP). However, consistent with Table B-9 of the QAPP, it states that while average daily temperatures should be maintained within 15 ± 1 °C, instantaneous temperature measurements can have excursions up to ± 3 °C. As such, both the average and the instantaneous temperatures were within the acceptability criteria of the QAPP throughout the duration of the study. Therefore no edits are required.
			Add a table summarizing mean temperatures for each replicate (e.g., expand the mean treatment temperature summaries in Table 5-2) and discuss how target temperatures were met or not for each replicate chamber. These data are relevant to the discussion of the potential for temperature affecting growth.	Comment acknowledged. As opposed to adding a table as requested, we have updated the Figures to illustrate recorded temperatures during the duration of the Study. Please refer to the above response to comment regarding temperature measurements and acceptance criteria as outlined within the QAPP.
51.	5.2	Figures 5-8a to 5-8i	Clarify the Figure titles by referring to pH rather than to "hydrogen ion activity."	Mathematically, pH is a measure of hydrogen ion activity. As such, the figures do not require clarification and are wholly accurate. Nevertheless we wish to confirm that we have updated the list of Acronyms and Abbreviations to address the reviewers' comment.
52.	5.2	Figures 5-8a to 5-8i	Discuss the relative importance (or uncertainty) associated with 2 to 3 pH unit variations in pH indicated in Figures 5-8a to 5-8i.	Table 5-2 lists the pH values for the duration of the study. The largest SD was ± 0.346 with a range of pH values from 7.42-7.76. Therefore there are no 2-3 pH unit variations and as such no discussion is necessary.
53.	5.2	Figures 5-9a to 5-9i	The figures indicate introduction of fish prior to temperature stabilization of the chambers. Discuss this in the text.	Comment acknowledged. However the figures do not indicate the introduction of fish prior to temperature stabilization, this is now clearer to see with the expanded y-axis, please see response to specific comment No. 46.
54.	5.2	Figures 5-8 through 5-37	Some data within these figures are difficult to read. Show a smaller range of y-axis values if possible to clarify the data presentations.	Comment acknowledged. The graphs have been revised where possible to limit the y-axis, please see response to specific comment No. 46.

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55.	5.2 to 5.3	Figures 5-8 through 5-16; 5-38 through 5-41, 5-43, 5-46	Include a clear legend explaining the use of different colors and lines for each figure.	A clear legend explaining the use of different colors and lines already exists and precedes Figures 5-8 through 5-16 and is titled "Legend and Template for Figures 5-8 through 5-16." Therefore there is no need for the legend to be on each figure and if included as suggested would hinder the presentation of data. The reviewer is reminded that the only thing that changes between the aforementioned figures is the analyte being plotted. Similarly, Figures 5-38 through 5-41 have clearly been described using a note at the base of each figure. There was a typographical error in the note which has now been corrected to read: "If ≤ 80% of measured concentrations were qualified (i.e., censored) maximum likelihood estimate procedures were used to derive geometric mean TUs. These calculations are identified with a less than symbol("<") positioned above respective columns. Sample types (e.g., porewater) are identified in the top left-hand corner of each plot, with replicate exposure chambers illustrated using the color scheme defined in Figure 2-3. The dashed line represents a TU of 1." Therefore all of the information required to interpret and understand data presented within Figures 5-38 through 5-41 is provided and does not require further edits beyond the aforementioned typographical error. We wish to confirm that a legend to distinguish replicate exposure chambers has been added to Figures 5-43 and 5-46.
56.	5.2.2.1	Table 5-3	Relative to all other measurements associated with the sediments, the air stone collections were consistently higher and extremely variable across the sediments. Sediment physical attributes were similar and they are from the same watershed, yet differences in major ions and other associated water quality chemistries seem extreme among the sites. Discuss blank samples collected using air stone and if they provide insight into these elevated concentrations. The potential for WS exposure to pore water 2.5 cm below the sediment surface is also not clear. Clarify whether these samples are to assess WS exposures or to better understand metal partitioning at the various sites.	We disagree with the premise of the comment and would like to remind the reviewer that a significant amount of methods development work was conducted prior to performing the Study through which, it was identified this particular airstone is an appropriate and unbiased means of collecting water samples. Furthermore the reviewer is reminded that airstone porewater measurements were collected at a different depth than other sampling techniques. The reviewer's comments inferring that airstone measurements are somehow "biased" simply because they are higher in concentration than peeper or DGT values are not defensible. Airstones provide a direct measure of constituents in the porewater matrix and represent operationally-defined dissolved values following filtration. In contrast, peeper and DGT values are indirect measures that depend not only on analyte concentrations, but sampler surface area, membrane characteristics, chemical diffusivity across membranes or into the gel, the kinetics of transport, the time of deployment in the sampled medium, and the potential for sampler saturation for cases of where large gradients exist. Therefore, consideration must be given to the characteristics of each sampling device and the constituent(s) measured before meaningful comparisons can be made. This was discussed in a technical memo submitted to EPA on July 9, 2010 reporting on results of methods development work (see, specifically "Time to Steady State of Water Quality Parameters."). Further discussion is beyond the scope of a data summary report; how these data will be used either interpretation of exposure of ELS white sturgeon or as a characterization of UCR sediment porewater will be determined during the Baseline Ecological Risk Assessment. The placement of airstones at depth (2.5 cm) was required in the QAPP following preliminary methods development; the intent was to provide information about the entire system. Whether and how they are used to interpret exposures to ELS white sturgeon is beyond the scope of a data summary report. Therefore no changes to the report are required.

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57.	5.2.2.1	5-4	Given the following: "*As indicated within Table 5-3, SWI concentrations of major cations/anions measured using suction (pipette) and peeper techniques were comparable, with calculated concentrations from DGT probes being very different. Given that DGT probes used in this Study were specifically designed and deployed to measure the flux of the four primary metals of interest (TAI 2010a,b,c), calculated concentrations of major cations for the DGTs likely reflects resin saturation*." it would be helpful if the text discussed if any data from DGT probes were useable and why. If all DGT data are not useable (i.e., underestimate concentrations due to saturation) then this needs to be explained in more detail, including a comparison to method development data where this was not an issue.	Please see response to SC #56. Additional assessment of the utility of DGT data is beyond the immediate scope of the data summary report. Additional data that can be used to interpret the DGT information were gathered during the methods development studies.
58.	5.2.2.1	5-4	Add a figure illustrating the data in Table 5-3 supporting the conclusion that measures of pore water concentrations were similar in peepers compared to suction samples (e.g., X-Y scatter plots with line of unity plus or minus 20% of unity).	Comment acknowledged. For the purposes of the data summary report however, summary statistics of relevant data are clearly presented in Table 5-3, and graphically displayed using a series of box-and-whisker plots (see Figures 5-17 through 5-37). This level of data presentation is more than adequate to support the general observations provided within the report. Furthermore the reviewers suggestion of employing a comparison line of ± 20% of unity may be appropriate; or it may not, but appears arbitrary. The reviewer should note that the precision for measurement of low concentration metals in replicate samples is not usually better than 20% in ideal situations in a laboratory (BC MoE, April 2013). Therefore, although we appreciate the suggestion such plots are not needed for the purposes of addressing study objectives or associated data reporting. Data summary reports are intended to provide brief summaries of data generated during a study. Speculation that devices with widely different characteristics should yield very similar results has no basis.
59.	5.2.2.2	5-5	Measured Cu concentrations are summarized for each treatment in overlying water, at the surface water interface, and in pore water. Add a description of any changes that occurred over the duration of the exposure for Cu, Cd, Pb, and Zn.	Concentrations of cadmium, copper, and lead in overlying water typically varying over time and by chamber by a factor of ≤3-4. Concentrations of zinc in overlying water are more variable but are influenced by estimated values and non-detects. Concentrations of cadmium, copper, lead, and zinc in porewater tend to be more variable than concentrations in overlying water of the sediment-water interface. Concentrations in DE chambers tend to be more variable than measured in chambers for other sites. Statistical summaries of cadmium, copper, lead, and zinc concentrations in overlying water, sediment-water interface water, and porewater samples are graphically presented in Figures 5-19 through 5-37. In addition, graphical summaries for conventional analytes are presented in Figures 5-8 through 5-18. Therefore, no revisions to the report are needed.

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60.	5.2.2.2	5-6	The report concludes that no statistical differences in Zn concentrations were evident across the treatments. Describe the statistical methods used to make these comparisons. Moreover, blank contamination clearly was a serious problem for Zn. The discussion should consider this blank contamination, any media or methods that were affected most, and to what extent.	Comment acknowledged. We have revised text related to the description of zinc concentrations in exposure chambers. We wish to confirm that the text in Section 5.2.2.2 now reads as follows: "Bulk zinc concentrations varied widely between Site sediments and reference sediments; variations were approximately 3 orders of magnitude (refer to Figure 5-4). Despite those large differences in bulk sediment concentrations, zinc in OW, SWI, and PW were much more consistent (refer to Figure 5-37). Average dissolved zinc in PW varied by roughly a factor of 2-3. Dissolved zinc concentrations of OW in control (H2O and CTRL) and reference sediment (LALL and GE) exposure chambers were consistent, with an average concentration of ≤3 µg/L. Overlying water zinc concentrations in exposure chambers for Site sediments were somewhat higher, with average values ranging between 6 and 10 µg/L. Differences in SWI zinc concentrations between controls, references, and Site sediments were judged to be relatively small given variations by sampling technique. Average PW (at 1 cm) zinc concentrations from exposure chambers containing Site sediments were generally ≥10 µg/L and, as illustrated in Figure 5-37, varied depending on sampling technique, with DGT probes having the highest concentrations. Regardless of that variability, zinc concentrations in PW (at 1 cm) from Site sediments were somewhat greater than concentrations in control and/or reference sediments, although such differences were generally small. Zinc concentrations in PWs collected at 2.5 cm were highly variable, ranging from 1 to 1,000 µg/L across all treatments and largely qualified due to blank contamination as illustrated in Figure 5-37."
61.	5.2.2.2	5-6	Provide additional discussion of treatments with elevated metal concentrations. For example, the statement that "*average dissolved Cd and Pb …in all exposure chambers …all sample types and all sampling techniques were generally 0.1 µg/L*" may be true, but misses the fact that (based on data in Figure 5-27) the nine greatest Pb values in pore water seem to be associated with 3 samples in each of DE, LD, and UMF sediments; and that all nine of those values approached 100 µg/L. Furthermore, the greatest median values for pore-water Cd were for sediments from DE and UMF. These data suggest that leaching of soluble Cd and Pb in at least two of the UCR sediments was observed at some point during the tests.	Comment acknowledged. However the reviewer must acknowledged as did EPA on July 16, 2010 that there are uncertainties associated with materials collected from Deadman's Eddy, not the least of which includes the fact that the material was collected in the dry (i.e., above the water line); and by definition is not sediment. Furthermore, the comment misses the fact that the purpose and primary Study question was (under laboratory controlled conditions) to assess potential toxicity of early life stages of white sturgeon to COPCs. Under laboratory conditions evaluated for this Study, despite the aforementioned elevated porewater concentrations, survival of white sturgeon was not adversely affected when reared on Site versus reference sediments. Therefore no edits to the data summary report are required.
62.	5.2.2.2	Figures 5-17 to 5-37	Include lines designating applicable ambient water quality criteria or state of Washington water quality standards available for metals in these figures.	Comment acknowledged and we wish to confirm that in drafting the report we did consider the inclusion of the aforementioned water quality criteria. However, given that both the national water quality criteria and state water quality standards are designed for the protection of aquatic life and human health in surface water; and all water data collected during this study was under controlled laboratory conditions, we came to the conclusion and continue to believe that making such a comparison would be a misapplication of the criteria/standards. Therefore no edits will be made at this time. However, data collected during this study will be placed in the appropriate context during the completion of the baseline ecological risk assessment.

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63.	5.2.2.2	Figures 5-17 to 5-37	Discuss apparent outliers in Figure 5-17 to 5-37. For example, there are many data points in the 2.5 cm pore water graph plotted about the "maximum" value in Figures 5-23 (Cr), 5-27 (Pb), and 5-37 (Zn). Explain how they all can be considered "extreme" when there are so many?	Data presented within Figures 5-17 through 5-37 are done so with the use of box-and-whisker plots. As a result and by definition, spacing between the different parts of the box help indicate the spread and skewness in the data, and by default identify outliers. As discussed within the note for each of the aforementioned Figures, the whiskers extend outside the upper and lower quartiles by 1.5 times the interquartile range, therefore data which lay outside this range are by mathematically defined as outliers (i.e., extreme values). We believe that the figures provide an efficient means to display differences between populations without making any assumptions of the underlying statistical distribution. Furthermore, the reviewer is reminded that to better represent data distributions a maximum likelihood estimate (MLE) procedure, which considers the presence of non-detectable concentrations when estimating the mean, median, and variance for a given dataset, was employed. Therefore no edits to the figures or text are required.
64.	5.2	Figure 5-27	Discuss the large variability in pore water Pb concentrations in SWIW and PW based on the sampling method. This example of chemical exposure data variability can be included in a discussion of uncertainties (see GC-9).	Comment acknowledged. Please see response to GC-9.
65.	5.2.1	5-3	Describe how control lab water was within the tolerance limit for white sturgeon early life-stages. A comparison between control water in the current study to the control water in past studies conducted with sturgeon may be helpful.	Comment acknowledged. The nature of water used for testing was described in the QAPP and analytical results for source/head water are presented in the project database. All analyses were within test acceptability criteria stated in the QAPP. Furthermore, the purpose of this report is to present and summarize data as collected during this study, as a result, comparing data from one report to another within a data summary report is not applicable.
66.	5.2.3	5-7	The existing text in Section 5.2.3 is a blend of methods and results. This blend is understandable since the results of the DOC blank corrections feed into the BLM methods; however, other details appear elsewhere in the report or have to be surmised. For example, "*BLM calibration was based on the lowest observed endpoint so as to provide a conservative screening evaluation*." But Section 5.4 indicates that LC20s were used (based on survival data only, not using sublethal growth endpoints). For Cd, Cu, and Zn, these were based on the semi-chronic test results of Vardy *et al.* (2011), and for Pb they apparently were based upon acute LC20s for white sturgeon. More specifically, using the critical accumulation value of 0.0042 nmol.gw from page 5-7 with the HydroQual BLM 2.2.3 parameters, a dissolved Cu concentration of 6.2 µg/L was predicted using our interpretation of the base water from the Vardy et al. (2011) tests (T = 15.6°C, pH = 7.92, DOC = 2.6 mg/L, Ca = 11.9 mg/L, Mg = 10.7 mg/L, Na = 7.1 mg/L, K = 1.05 mg/L, SO4 = 43 mg/L, and alkalinity = 63.5 mg/L.) This 6.2 µg/L estimate is close to the various LC20 estimates for that test (6.76 µg/L in Cardno Entrix et al. (2012), in their Table 10; 3.4 or 5.5 µg/L in Vardy et al. (2011), their Table 4; or 7.2 µg/L in the Chapter 2 of Ingersoll and Mebane (In review).	Comment acknowledged. The reviewer's summary of the BLM analysis is correct. All BLM calculations and calibration were driven by the lowest observed survival endpoint report in any of the recent sturgeon studies. In this case, the 2008/2009 U of S data were associated with the lowest concentrations where effects were observed. No edits to the report are required.
			Add a table describing specific details of the BLM parameters to help clarify the approach used.	Comment acknowledged. We wish to confirm that BLM calculations and associated input/output files have been included as Appendix H within the revised report.

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67.	5.2.3	5-7; Figure 5-46	The *introduction to Section 5.2.3 explains that the "application of the BLM resulted in 5,632 different BLM predictions for each metal."* However, these many predictions were apparently averaged or somehow rolled up to a more manageable and comprehensible summary for each exposure. For example, from Figure 5-46 for Cu, it looks like there were about 140 exposures that were modeled for each metal. Figure 5-46 and its companions were nicely envisioned and prepared in a way to visualize the results of a complex study. Provide a summary of the BLM modeling data and calculated values from Figure 5-46 to aid in data interpretation. This could be made available electronically.	Comment acknowledged, please refer to response to specific comment no. 66.
68.	5.2.3	Figures 5-38 to 5-41	The large incidence of "<" flagged plot data makes the validity of "TU" (toxic unit) calculations questionable. Reiterate points from previous discussion on the validity and usefulness of chemistry data to describe the uncertainty in TU calculations (See GC-9).	Comment acknowledged. The reviewer is reminded that when a measured concentration was a less than detect, the corresponding TU value was also indicated as a less than detect to acknowledge the uncertainty. We find this simplifies analysis because the TU represents an upper bound and is the most appropriate way to analyze the data. Please also see response to comment GC-9.
69.	5.2	5-8	WS larvae often have wide variation in size and growth rates between individual fish, and the report did not describe how the investigators accounted for this. Discuss the variability in WS larvae size at the beginning and end of the test (controls) to account for the natural variability in this species life history. Comment on how the hatch occurring over 4 days may have contributed to the observed variability and how it might have affected data analyses. This issue could be discussed as an uncertainty or lesson learned (see GC-9).	Comment acknowledged. The reviewer is reminded that this is a data summary report and as such, we believe that this degree of data analysis and interpretation is beyond the immediate scope. The reviewer is correct in that sturgeon did hatch other a several day period and the test initiation date represents an effect age of 1 dph for sturgeon fry. However, the sample of fish weights at an effective time of 3 dph suggest that potential variation is relatively small and as such would not affect data analysis.
70.	5.3.1	5-10	There seems to be outliers in the survival data for some treatments (e.g., UMF replicate F, Control replicate A) that contribute to lower overall survival in these treatments; although still greater than the TAC of 64%. Explain possible reasons for these results.	Comment acknowledged. However based on analytical data collected during this study it is clear that differences in survival for these treatments is not related to analytical (i.e., chemistry) data. Furthermore and as correctly identified by the reviewer acceptance criteria were met. Therefore, for the purposes of a data summary report it is inappropriate to speculate on non-chemical factors.
71.	5.3.1	Figure 5-42	There are 9 treatments indicated in the legend of Figure 5-42 but only 6 lines can be distinguished. Revise this figure so the data are clear.	Comment acknowledged however we disagree with the reviewer. Whenever data have similar values, they will plot near each other. It is generally well understood that data plotting this close to each other have similar values. Therefore the figure has not been revised.
72.	5.3.2	5-11, 5-12	The influence of fish density on growth is described at length; however, the potential for this confounding factor was recognized in the QAPP (page A-12) so that "Initial seeding densities for all treatment chambers will ensure that fish density will not confound overall survival rates." Discuss why density dependent effects were a persistent issue in the results (see QAPP Tables B-5 and B-6) even for treatments that did not exceed the planned seeding density.	Comment acknowledged. As was noted in GC 6D, sturgeon are a less well studied species, as such seeding densities set by the QAPP may not have been appropriate. Comment acknowledged. As was noted in GC 6D, sturgeon are a less well-studied species. As such there is uncertainty as to what seeding densities may be "optimal". This study was designed based on seeding densities set by the QAPP approved by EPA. Furthermore, restocking the test chambers where fish were lost at the beginning of the study resulted in uneven stocking densities, refer to Table 2-4. Despite these challenges, the study met its objectives by characterizing the response of ELS sturgeon reared on UCR site and reference sediments, using statistical approaches to account for differences in stocking densities across the various treatments. For instance, use of the Kaplan-Meier survival analysis approach accounts for differences in the number of fish over time across the various treatments. Therefore no changes are required to the text.

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73.	5.3.2	5-1- to 5-12	The text is internally inconsistent when it states first that "*With only one exception, fish density within exposure chambers explained all of the variation observed in size (length and weight)*", and later states that density explains only 53-57% of variability in length and weight. Clarify these statements so they are consistent and expand the discussion of the WS growth endpoint to include other variables that could explain the remaining 43-47% of variability among treatments. For example, do temperature differences among replicates further explain this variability? The biomass endpoint may be helpful in this discussion (see GC-5 and GC-9).	Text on pages 5-11 and 5-12 has been revised to address this comment. The paragraph on p. 5-11 starting with "Length and weight of fish surviving..." and ending with "for weight and length, respectively)." was replaced by the following: "Multiple sets of ANCOVA analyses were performed to determine which variables (e.g., fish density, sediment site, etc.) had the greatest explanatory power. Length and weight of fish surviving to test termination were observed to vary as a function of number of fish (density) remaining at EOT. To assess the effect of sediment type on growth endpoints, it was assumed that the slope of the relationship between the endpoint (i.e., length or weight) and the number of fish surviving at EOT was equivalent for each sediment type. This assumption was unavoidable because of the unbalance in numbers of replicate exposure chambers (i.e., with only two replicate NP exposure chambers, the slope would have been strongly positive, when a reasonable slope is either zero or negative). This ANCOVA used one overall slope and an intercept for each data series, where data series indicates a specific sediment source. The statistical comparison is essentially a comparison of intercepts with a control or reference condition (see Figure 5-44 for weight and Figure 5-45 for length). Fish density within exposure chambers was the primary explanatory variable for variations in size; p-values for effect of fish density on length and weight were 7.81E-06 and 3.81E-06, respectively. The exception was a small but statistically significant reduction in fish size for the UMF treatment. An additional ANCOVA was conducted to evaluate the effect of temperature on fish size. Results of this additional ANCOVA indicate that temperature has a statistically significant influence on fish length and weight; p-values for the additional effect of temperature on length and weight were 0.0126 and 0.0283, respectively. When both fish density and temperature were included, fish from the LD and UMF treatments were statistically smaller than fish from reference treatments; p-values for LD for length and weight were 0.0217 and 0.0472, respectively and p-values for UMF for length and weight were 0.000741 and 0.00141, respectively." Subsequent text on p 5-12 (starting with "A relationship between fish weight..." and continuing through the end of the paragraph) was expanded as follows: "Three factors explained nearly 77% of the variation observed in size (length and weight): fish density, site, and water temperature. Fish density within exposure chambers explained 53-57% of the variation. Site and water temperature explained much less of the variability. Site explained 13-15% of the variability. Temperature explained 7-9% of the variability."
74.	5.4	5-12	*"For the purpose of this Study, BLM-predicted effect concentrations are metal-specific, were developed using the lowest observed effect concentration for survival of white sturgeon, and were based on metal concentrations associated with a 20 percent reduction in survival."* Please clarify this statement. For example, isn't the concentration associated with a 20% reduction in survival referred to as an LC_{20}, rather than a LOEC? Whereas the LOEC would be a measured concentration (in one of the sampled sediments) associated with a statistically significant effect. If LOECs were determined, then this would be contrary to previous statements that there were no significant differences between Site samples and reference samples.	Comment acknowledged, please refer to response to specific comment nos. 66 and 67.
			Also, additional detail is needed describing the rationale using a 20% reduction in survival of sturgeon as the endpoint modeled with the BLM. Explicit explanations on the sources of LC20 values used in the analysis (if from other sources) are needed.	The BLM was calibrated to chronic (Cu, Zn, Cd) and acute (Pb) WS toxicity test results from 2008 and 2009 work completed by the Uof S as they represent conservative values. These BLM calibrations had the lowest calibrated critical biotic ligand accumulation levels for all sturgeon results considered (including USGS sturgeon results). The LC20 is a common chronic endpoint. Survival endpoints were used rather than growth because of the potential for seeding density seeding to confound interpretation of growth results.

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75.	5.4	5-12	Discuss the rationale for using a 20% reduction in survival of sturgeon as the endpoint modeled with the BLM. Include the sources of LC20 values used in the evaluations.	Comment acknowledged, please see response to specific comment's 67, 68, 73, and 74.
76.	5	Figure 5-43	A key describing the colors used is needed.	Comment acknowledged, please see response to specific comment 55.
77.	Appendix A		Add missing methods to Appendix A: Standard Operating Procedure SOP-18. Decontamination, Deployment, and Retrieval of Diffusive Sampling Devices, dated July 20, 2010.	Comment acknowledged. SOP-18 as submitted to EPA on July 21, 2010 has been added to Appendix A.
78.	Appendix B, Section 2.1.1	B-3	Change "*...eggs from two female and two male adult white sturgeon...*" to "*...eggs from two female and sperm from two male adult white sturgeon...*"	Comment acknowledged. The text has been amended.
79.	Appendix B, Section 4.1	B-9	Were there any rejected data from the acute tests? If so, present them.	None of the results from the acute white sturgeon toxicity tests were rejected. The text in Section 4.1 of Appendix B has been revised to further clarify this as follows: "Table B4-1 summarizes the number of samples with each type of data qualifier, by analyte; there were no rejected results."
80.	Appendix B	B-14	DOC measurements seem to be treated differently in Appendix B than in the main report and blank contamination is not reported (Section 4.3.2; Table B4-1). Discuss why these measurements were immune from the problems associated with DOC measurements in water samples from the chronic toxicity experiment and, as appropriate, calculate the range of BLM effect levels that can be determined within the reported range of measured and/or corrected DOC concentrations (see GC-7).	The reviewer is correct. DOC values in this situation were not blank-corrected. Doing so would increase LA20 values and would increase BLM-normalized LC20s. Using reported DOC provides a more conservative approach that infers greater potential for effects. As a result, the analysis presented herein represents a conservative evaluation and is appropriate. Therefore no edits to the document are required.
81.	Appendix B	Table B5-1	Delete the overall mean Cu concentration across the six treatments in the serial dilution as this summary statistic is of limited value.	Comment acknowledged. Overall mean value from spiked tests was deleted from Table B5-1.
82.	Appendix B	B-15	Briefly discus the RBT test results (e.g., water quality measurements and control survival) in the Data Summary and Evaluation section, as is done for WS exposure data.	Comment acknowledged. The following text briefly summarizing rainbow trout tests results for water quality measurement has been included. "As illustrated within Table B5-2, the average daily temperature recorded within white sturgeon acute exposures was 15.1°C, which is within the test acceptance criteria of 16 ± 1°C; and instantaneous temperatures were within ± 3°C of 16°C (TAI 2010a). Similarly, DO concentrations within white sturgeon exposures were maintained above the minimum test acceptability requirement of 70 percent of saturation; while all other water quality parameters did not vary by more than 50 percent. Therefore, routine water quality parameters measured within all white sturgeon exposures met minimum test acceptability criteria throughout the duration of the Study. Similarly, the average daily temperature recorded within rainbow trout acute exposures ranged from 11.5 ± 0.2°C to 13± 0.6°C (average of 12.25°C),which is within the test acceptance criteria of 12 ± 1°C (TAI 2010a). Similarly, DO concentrations within rainbow trout exposures were maintained above the minimum test acceptability requirement of 70 percent of saturation; while all other water quality parameters did not vary by more than 50 percent. Therefore, routine water quality parameters measured within rainbow trout exposures met minimum test acceptability criteria." Please note that text discussing control survival for rainbow trout tests already existed and as such, did not require further edits.
83.	Appendix B	B-17; Table B5-5	It is helpful to see a summary table of the length and weight data in this appendix. A rough visual assessment of the length and weight data reported for surviving WS and RBT does not seem to indicate a strong dose response relationship. Comment on whether there are any statistically significant differences among treatments for each test.	Comment acknowledged. Lengths and weight of each fish are made available in the database. We would like to remind the reviewer that means and standard deviations are included in Table B5-5 and a statistical analysis using box-and-whiskers plots is provide in Figure 5-43. We believe this level of statistical analysis is more than adequate for the purposes of a data summary report. As such, no additional edits are required.

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84.	Appendix B, Section 5.4, and 6	B-19, B-22	Are the measurements accurate enough to determine an LC50 to a one-tenth or one-one hundredth of a microgram (e.g., 13.2 ug Cu/L on page B-19, 12.71 ug Cu/L on page B-22, and in Table B5-6)? Consider the appropriate number of significant digits that should be presented for these data.	Comment acknowledged. All copper concentrations in the Acute dataset are described as having 3 significant figures and are always reported at either the 0.1 or 0.01 decimal position (i.e. as tenths or hundredths of a µg/L); None of the LC50 or LA50 annotations need to be modified in Appendix B, because they used a maximum of 3 significant figures in all cases where LC50 or LA50 were calculated.
85.	Appendix B	B-21	It is inappropriate to conclude that "*state and national acute water quality criteria would be protective of white sturgeon and rainbow trout*" based on dissolved Cu 96-hr LC50s that are close to the WQC. Revise this conclusion to say that state and national acute water quality criteria would be protective of acute lethality to half of a white sturgeon population exposed to Cu under conditions comparable to those evaluated at the ages tested.	WQC are designed to protect the 5th percentile of the species sensitivity distribution. The LC50 is a 96 hr value, the WQC assumes only a 24 hour exceedance, sturgeon LC50 are greater than WQC so we should always be protective at least 99% of the time. If an exceedance for a 24 hour period were to occur, the fraction of the population is expected to be much less than the 50% affect level obtained in a 96-hr test. This being the case, it is appropriate to conclude that "based on the test conditions and life-stages evaluated herein, both state and national acute water quality criteria would be protective of white sturgeon and rainbow trout".
86.	Appendix B	B-21	Clarify the discrepancy among reported acute Cu LC50s for WS where values in Table B5-6 differ from those stated in the Discussion and Recommendations section. The text on Page B-22 states "*... 16 and 45 dph to be 12.71 µg Cu/L and 26.93 µg Cu/L, respectively*." Table B5-6 indicates these LC50s to be 15.84 and 29.51 for 16 and 45 dph WS, respectively.	Comment acknowledged. The table is correct. The text has been revised to reflect the proper values: 15 at 16 dph and 29 at 45 dph for WS, thank you for the comment.
87.	Appendix B	Figure B5-1	Explain the meaning of the green line.	Comment acknowledged. The reviewer is directed to the note associated with the Figure which clearly defines that " The solid green line represents the overall mean copper concentration, while respective treatment averages are depicted with a large diameter red dot..." Therefore no edits are required in the document.
88.	Appendix B	Figure B5-4	Clarify why the term "LA50" is used instead of "LC50".	Comment acknowledged. LA50 values (i.e., the metal accumulation at the biotic ligand that results in 50% mortality are used to represent the accumulation of metal at the biotic ligand) is consistent with the model. The reviewer is reminded that units are nmol/g rather than µg/L, hence accumulation, not concentration.
89.	Appendix B	-	Include calculations of the LC10 and LC20 endpoints.	Comment acknowledged. In acute toxicity tests, LC50 values are routinely the reported endpoint and as such we believe sufficient.
90.	Appendix E	Figures	Include available TEC and PECs from MacDonald et al. (2000) in these figures (i.e., individual PAHs, total PAHs, Total PCBs, Total DDTs) and include a legend or note similar to those in Figures 5-1 through 5-4 to explain the horizontal and vertical lines.	A legend page similar to that used for Figures 5-1 through 5-4 has been added to Appendix F (formerly Appendix E). All figures use a consistent format. Descriptions of lines used to indicate distribution 90th percentiles values as well as TECs and PECs (where applicable) are provided. With respect to organic chemicals, lines have been added to distributions for those individual compounds that have TEC or PEC values. However, and consistent with the original appendix, we have not generated distributions for cases where chemical concentrations must be summed (e.g., Total PAH, Total PCB, Total DDTs, etc.) before comparison to TEC or PECs can be made. Construction of distributions from such summations are beyond the scope of a data summary report. Considering PCBs as an example, data for nearly all congeners were below detection limits and there were unequal numbers of congeners reported in each sample (i.e., not all congeners were reported). In such cases, summations would merely reflect a sum of unequal numbers of variable detection limits. Evaluations of constituents involving organic chemical concentration sums and comparisons to their applicable TEC and PECs are more appropriately part of data interpretation tasks conducted as part of the BERA.
91.	Appendix G	Figures	Include an explanation of the dashed grey lines in Figure legends.	A legend page was added in front of the survival analysis figures. With this legend page added to the appendix, no text revisions should be needed in the report.